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REPORT
OF THE
ELECTRICAL MACHINERY
AND
EQUIPMENT PANEL
ON THE
DEVELOPMENT OF ELECTRICAL
INDUSTRIES

GOVERNMENT OF INDIA
DEPARTMENT OF INDUSTRIES & SUPPLIES

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THE PANEL.

Chairman

Sir Ghulam Mohammed, Kt., C.I.E.

Members

Khan Bahadur A. G. Khan, C.I.E., B.A., M.Sc. Tech. (Manchester).
M.I.E.E., M.I.M.E., M.I.E., Deputy Director General (Disposals)
Department of Industries and Supplies, New Delhi.

Mr. E. V. Small, Managing Director, Messrs. Associated Electrical
Industries (India), Ltd., Crown House, 6 Mission Row, Calcutta..

Mr. H. M. Mathews, Electrical Commissioner with the Government of
India, Simla.

(Mr. H. S. Kulkarni attended meetings on behalf of Mr. Mathews.)

Mr. Kishenchand, Managing Director, Messrs. Kaycee Industries Ltd., The
Mall, Lahore.

Mr. R. D. Char, B.E., Chairman, Messrs. Standard Batteries Ltd.
Bombay.

Mr. V. S. Risoe, M.B.E., c/o Messrs. Associated Electrical Industries-
(India) Ltd., Crown House, 6 Mission Row, Calcutta.

Mr. B. K. Rohatgi, Managing Director, Messrs. India Electric Works Ltd.,
25 South Road, Entally, Calcutta.

Dr. M. T. Ahmad, D.Sc. Eng. (Berlin), C.E. (London & Berlin).
Civil & Hydraulics Engineer, 3 Sharif Building, Brandreth Road,
Lahore.

Mr. Shivraj Bhalla, Managing Director, Messrs. Electrical Fan & Motor
Manufacturing Co., Ltd., Grand Trunk Road, Shahdara, Lahore.

Mr. H. Sur, O.B.E., B.A., C.E., Retd. Chief Engineer, Posts and Tele-
graphs Department, Calcutta.

Mr. A. J. Emery, Director and General Manager, Messrs. General
Electric Co., (India) Ltd., Central Avenue, Calcutta.

Prof. S. K. Roy, M.E.E. (Harvard), M.A.I.E.E., M.I.E. (India).
Director, Messrs. Bengal Electric Lamp Works Ltd., 190-C, Rash-
Behari Avenue, Calcutta.

Secretary

Mr. T. M. Merchant, M.B.E., B.Sc. Tech. (Manchester), M.I.E. (India),
Deputy Industrial Adviser, Department of Industries and Supplies.
New Delhi.

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PREFACE

(i) *Scope*.—The Electrical Machinery and Equipment Panel was constituted by the Planning and Development Department of the Government of India to make recommendations to the Government regarding the post-war development of both existing and new electrical machinery and equipment industries in India. The general directive issued to Industrial Panels (Appendix I) constitutes the terms of reference of the Panel.

(ii) *Membership*.—The Panel was constituted as far back as March 1945 but it was unable to commence its work as the Government could not appoint a Secretary till April 1946.

The Main Panel and Sub-Panel originally formed by the Government consisted of the following:

Main Panel.

Mr. (now Sir) Ghulam Mohammed.	(Chairman).
Mr. H. M. Mathews.	Members
Mr. Kishenchand.	(,)
Mr. E. V. Small.	(,)
Mr. R. D. Char.	(,)
Mr. V. S. Risoe.	(,)
Khan Bahadur A. G. Khan.	(,)

Sub-Panel.

Mr. B. K. Rohatgi.	(Chairman).
Dr. M. T. Ahmad.	Members
Mr. K. C. Roy.	(,)

Subsequently owing to the sad demise of Mr. K. C. Roy, the Sub-Panel was allowed to lapse and Mr. B. K. Rohatgi and Dr. M. T. Ahmad were nominated as members of the Main Panel. At the suggestion of the Panel, the following were co-opted as members of the Panel:—

Mr. A. J. Emery.
Prof. S. K. Roy.
Mr. H. Sur.
Mr. S. Bhalla.

Dr. M. T. Ahmad left for England on 21st June 1946, with the Technical Mission appointed by the Government of India and could not attend the Panel meetings. Mr. V. S. Risoe resigned his membership on 10th August 1946. At the first meeting of the Panel, Mr. H. M. Mathews gave a talk on the post-war development of electricity supply but thereafter owing to heavy pressure from Government on his time, he could not attend the subsequent meetings. He, however, deputed Mr. H. S. Kulkarni of his Office to be associated with the deliberations of the Panel on his behalf.

(iii) *Panel Meetings*.—The Panel met for the first time at Calcutta on 16th, 17th and 18th May 1946 and held its second meeting also at Calcutta on 26th and 27th June 1946. At the latter meeting representatives of the Indian Chamber of Commerce, Calcutta, and the Bengal Chamber of Commerce, Calcutta, were interviewed. The third meeting was held at Bombay on 12th, 13th and 14th August 1946, when representatives of the Indian Merchants' Chamber, Bombay, the Chamber of Commerce, Bombay,

All-India Manufacturers' Organisation and Director of Industries, Bombay, were interviewed. The fourth meeting was held at Bombay on 25th and 26th November 1946 and representatives of Provincial Governments and States were invited to attend the last meeting held on 22nd April 1947, at New Delhi.

At the second meeting, two Sub-Committees for Heavy Electrical and Light Electrical Industries were formed, to study and formulate preliminary recommendations in respect of these industries. The Sub-Committees consisted of the following members:—

Heavy Electrical Industries Sub-Committee

Mr. Shivraj Bhalla (Chairman).
Khan Bahadur A. G. Khan.
Mr. E. V. Small.
Mr. H.S. Kulkarni.
Mr. Kishenchand.
Mr. B. K. Rohatgi.
Mr. T. B. Merchant (Secretary)

Light Electrical Industries Sub-Committee

Mr. H. Sur (Chairman),
Mr. Shivraj Bhalla.
Mr. A. J. Emery.
Mr. R. D. Char.
Mr. B. K. Rohatgi.
Mr. Kishenchand.
Mr. T. B. Merchant (Secretary)

The list of items dealt with by the Sub-Committees is given in Appendix II.

The meetings of the Light Electrical and the Heavy Electrical Industries Sub-Committees were held on 23rd and 24th July 1946 and 25th and 26th July 1946 respectively in Calcutta.

(iv) *Plan of Work.*—The Panel visited the factories of Messers Associated Electrical Industries Manufacturing Co., Ltd., Calcutta and Messers. India Electric Works Ltd., Calcutta. The Secretary visited several other factories at Calcutta and Bombay.

For collecting relevant information questionnaires (Appendix III) were sent to 168 important industrial firms, 28 principal Chambers of Commerce and Trade Associations and 13 Provincial/Central Government Departments. Representatives of certain firms were also interviewed by the Panel.

I have to record with regret that, inspite of the greatest efforts, information made available by certain industrial firms and Government Departments, has been most unsatisfactory. Altogether over two hundred parties were approached for information but the response was extremely poor.

The Panel's work was considerably handicapped by the All-India Postal Strike and the disturbed conditions prevailing in the country.

(v) *Acknowledgements.*—I am grateful to the members of the Panel and the various organizations that co-operated in providing useful advice and information which have been of considerable assistance in the preparation of the Report.

Although every effort has been made to ensure the accuracy of information presented in this report it is to be noted that the Panel does not accept responsibility for any errors or omissions.

CHAIRMAN.

INTRODUCTION

1. The Government of India in a statement of Industrial Policy issued on April 1, 1945, have categorically stated that Government have decided to take positive steps to encourage and promote the rapid industrialization of the country to the fullest extent. The Government have laid down the fundamental objects of industrialization to be three-folds:—

- “(i) To increase the national wealth by the maximum exploitation of the country's resources. It is well known that there are considerable unsued resources of man ower and material, and clearly Government policy must be directed towards stimulating their fullest and most effective utilisation.
- (ii) To make the country better prepared for defence. The experience of two Wars has demonstrated the dangers, both to India and to the rest of the Commonwealth inherent in India's independence on cverseas supplies for vital commodities required for defence.
- (iii) To provide a high and stable level of employment. At present the volume of industrial employment is comparatively speaking small but if the country's industrial resources are developed to their maxinum possible extent, Industrial employment in ancillary trades and professions, will considerably affect the volume of total employment in the country. Government consider that their industrial policy should be directed towards maintaining employment at the highest possible degree of stability and volume.”

2. In dealing with an industry like the one before us we cannot forget the fact that the products of the industry have a wide application in every field of life. The indirect benefits to the country at a stage when rapid all-round industrialization is the target, cannot be ignored.

3. We have kept in view the necessity of developing the industries on commercially sound lines. Where we have disgressed from that objective we had to bear in mind the needs of the industry as a whole. Nevertheless, we have in our recommendations not endeavoured an experiment of doubtful value.

4. **Benefits to the Country and Other Industries.**—The development of local manufacture of electrical machinery and equipment at an economical price is bound to result in extensive benefit to the country. For example, the increasing use of Refrigeration Plant will assist the development of fisheries, storage of agriculturist products particularly, milk, medicines and such other products as are highly sensitive to climatic conditions prevailing in the country. With the proposed expansion of electrical energy it should be possible for the industry under investigation to provide numerous items of equipment to assist the expansion of cottage industries, which are very necessary to increase the purchasing power of an agricultural country like India.

5. It is well-known that the medical and educational facilities provided in the country in the shape of hospitals, nursing homes, schools, colleges, etc., are very inadequate for the needs of the country. It will be the responsibility of Indian industry to provide electrical equipment for institutions of this nature, which, with the schemes that Government have for improvement of such facilities, should give the electrical industry ample incentive for improved and efficient production.

6. The estimated consumption of radio sets and equipment is expected to be approximately ten times that of pre-war level. Such factors as heavy customs duty and middle-man's high profit have prevented the popularity of radio sets in this country. Yet the people have without doubt realised the value of keener interest in world events and with the aid of cheap and efficient locally manufactured radio sets, as recommended in this Report, it will be

possible to institute a country-wide drive against illiteracy and ignorance prevailing in the vast population of the country.

7. The labour costs in India are rapidly increasing and it is essential that proportionate increase in efficiency also is achieved to ensure that the industries do not suffer owing to high labour costs. In America as labour costs increased, the industries adopted more and more extensively mass production methods which have now become a specialised feature in that country. Electrical machinery and equipment play an important role in the development of mass production method.

8. It will be seen from above that the industry under investigation is of extreme importance in very field of life. The Panel believe that adequate measures have been specified in the Report for economic and efficient manufacture, and whilst it is necessary for the industry to play its part, it is equally incumbent on Government to provide the assistance and facilities necessitated by the industrial backwardness of the country. For example, in any steps that Government take for improvement of purchasing power, education, agricultural conditions or health of the country, the first effort should be for Government to standardise the type of equipment to as narrow a range as conditions would permit, so as to assist in bulk production. It will also be necessary for Government to assist in research and maintaining of up-to-date information in regard to development in foreign countries, which should be made available to the industry readily. In short there should be close co-ordination and co-operation between Government and industry, until the latter levels up with the standards achieved in foreign countries.

9. **Factors in Production.**—*Power*—There has not been sufficiently cheap electrical power available in the country in the past for industrial purposes. With the completion of Hydro-electric schemes referred to in a subsequent chapter and the nationalisation of electrical power so as to provide distribution at low costs, one of the greatest handicaps to the industry in the past will be removed.

It is hoped that Government will give special consideration to all industries in their scheme for supply of cheap power, but the needs of the electrical industry should receive special attention because of its value to the development of other industries. It is necessary to emphasise that apart from providing power at a low cost, Government should standardise machinery and equipment of all Power stations, so that the local industry gets the maximum benefit from the proposed developments.

10. **Skilled and Unskilled Labour.**—Drifting of labour is a common tendency owing to the increasing scarcity of properly trained labour. To improve efficiency and maintain a high standard of quality, it will be necessary that migration of labour is reduced to minimum possible and takes place if necessary under arrangement between the Governments concerned. One of the essentials will be to provide good residential and health facilities at all industrial centres. The Panel recommend in a later Chapter the steps that they consider Government should take for improvement of training and education of the higher technical staff. In regard to skilled and unskilled labour, however, the industry will be greatly responsible for providing adequate facilities for training, but unless measures to prevent drifting of labour are taken, any facilities that the Industry may provide will be of little benefit.

11. **Transport.**—The Railway Department generally determine freight rates on the basis of the value of goods to be transported in comparison with their

bulk or weight and liability to breakage A schedule is given below for facility of comparison.

<i>Commodity.</i>	<i>Rate charged per maund per mile Pies</i>
Battery containers, cells, bulbs, fans & components, meters, electrodes, heating and cooling appliances.	0·89
Wiring material such as ceiling roses, connectors, lamp holders, switches, etc., bus-bars, electric bells, fuse units, insulators, rubber insulated cables.	0·77
Accessories for overhead transmission lines, alternators, armoured cables, circuit breakers, condensers, motors, hard drawn copper conductors, generator, motor controllers, transformers, witchgear, welding machinery.	0·58
Wooden battens	0·42
Castings, pulleys, railings, expanded metal, agricultural implements.	0·46
Beams, bars, hoops, rails, plates, sheets	0·42
Billets, blooms, pig iron	0·38
Machinery other than electrical	0·5
Amusement machinery	0·89

It has not been possible for the Panel to collect comparative freight rates prevailing in foreign countries. The Panel is not in a position to express an opinion as to whether, from the All India aspect, the transport system could bear the loss of revenue resulting from reduction of freight rates on the items of electrical machinery and equipment. However, it is recommended that Government should undertake necessary investigations for purposes of adjustment of freight rates giving due consideration to the importance of economic distribution of electrical equipment and machinery for the essential purposes referred to before.

The transport system of the country has in the past been found to be very inadequate for the needs of the country and there is no doubt that the development of various industries will outpace the improved facilities that Government at present contemplate. Particularly as regards electrical equipment and machinery, it is necessary to emphasise that many items are of a very delicate nature and for the transport services to be of maximum benefit, it will be incumbent to provide better handling facilities than at present exist at most of the Railway stations.

12. Raw Materials.—It will be seen from the Chapter on “Availability of Raw Materials” that the industry is happily situated in regard to many items. At the same time, owing to lack of processing facilities the availability of certain important items is of little benefit. In this place, it will suffice to emphasise that the development of necessary processing facilities is essential. Owing to the vastness of the country the transport system will again play an important part in economic distribution of raw materials. Long overland transport is bound to cause severe freight disadvantage to the industrial centres distantly located from sources of raw material, which can only be overcome by introduction of telescopic rates for long haulages.

CHAPTER I

Statistical Data

13. To ascertain the manufacturing targets to be aimed at by the electrical machinery and equipment industry it was essential to obtain a clear picture of

the requirements of the country. It is to be noted that there is hardly any statistical information available in India from which the various demands could be worked out. The import figures as given in the Publications for Sea-Borne Trade are the only available information. These figures are in rupee values with no mention of quantities and categories of respective equipment. It was impossible, therefore, to tell for a given category, such as electrical motors, as to what proportion of the total imports was represented by direct and alternating current motors of different types and sizes. The Government statistics with respect to products manufactured in India, with which the Panel was concerned, are fragmentary and incomplete, otherwise a picture could be obtained of the normal market for a given category by adding to imports the production in India. The importance cannot be over-emphasised of maintaining accurate statistics of imports as well as production in India, suitably classified, with details as to amounts in rupees, quantities, types and sizes. Government would be well-advised to give foremost consideration to this all-important aspect of statistics if future planning is to meet with success. These statistics would help the industrialists of the country in developing the existing industry and entering into fresh enterprises.

14. With the exception of a few items there has been very little manufacture of electrical machinery and equipment in the country. As such import figures wherever available, have been taken as a fair indication of the country's demands. The six years of war have had a very disturbing effect on the imports and its consequences cannot be stated to have passed with the end of war. During the war period the law of supply and demand could not be taken to be freely operative for the determination of these demands, and hence recourse has had to be taken to the pre-war period figures, when market conditions were more stable. This going back by six years introduces possibility of errors and it has been kept in mind when estimating the demands referred to above.

15. The only rational method of ascertaining the requirements of the country is by classifying them under four headings:—(i) Pre-war demand, (ii) Pent-up war period demand, (iii) Post-war quinquennium demand, and (iv) Sustained demand. This fourth demand is a major factor which, together with the volume of export, will determine the extent of the development of manufacture of electrical machinery and equipment in the country.

16. **Pre-war demand.**—The import data available is only in respect of a few major industries. Mere value of equipment and machinery is a highly variable factor and if such values are to be worked out to a comparable basis, it is necessary to know the yearly cost index figures for that particular type of machinery and equipment. Such direct cost index figures are not available which is a serious handicap to our investigation. However, these have been adjusted on the basis of yearly cost index figures worked out by the Panel. The index value for the years 1935-36 was taken as 100 and the import costs for the other years have been adjusted on this basis. Appendix IV gives the import values for electrical machinery and equipment as reported in the Sea Borne Trade Publications for 1935-45 and corresponding adjusted values in Appendix V.

17. **Pent-up War Period Demand.**—The corrected import values averaged out for the years 1935-39 and 1939-45 were adjusted as follows to arrive at the pent-up demand. In this calculation the pre-war average normal demand was taken to be also the average normal demand during the war period. The average imports for civilian requirements during the years 1939-45 were deducted from the pre-war average normal demand. The figures thus obtained were further adjusted for reduction caused by efflux of time, gradual change over from D. C. to A.C. supply and the Defence Service surpluses. The war period pent-up demand finally arrived in the manner stated is of great importance.

for planning the development of electrical machinery and equipment industry during the next five years and is to be added to the normal demand including that for replacements, improvements, new projects, etc.

18. Post-war Quinquennium Demand.—As detailed in a subsequent chapter, Posts and Telegraphs Department, Railway Department, Office of the Electrical Commissioner and Office of the Textiles Commissioner, have plans for development of services or industries during the next five year period. These plans cannot be taken as final owing to certain limitations. They will need modifications depending upon such factors as availability of finance and technique and pace of development possible. Estimates are given in most cases for electrical machinery and equipment that would be required for the proposed development in the next five years. The co-related and co-ordinated estimates for these new projects form a large part of demand under this heading.

19. Sustained Demand.—The normal annual demand of the country after the post-war five year period, which is inflated by several disturbing factors, is taken as the 'Sustained Demand.' Importation of capital goods and machinery from abroad is at present difficult and it is likely that foreign manufacturers will continue to be engaged on home orders for the next few years, so that India's requirements will not be fully met. The same difficulty will be experienced in regard to technical aid. These factors, combined with the fillip given by Government to the various development plans and the industry as a whole, will determine to a considerable extent the needs of the country five years hence. We have attempted in this Report to arrive at 'Sustained Demand' by a rational visualisation of the factors involved.

CHAPTER II

Conditions of Trade and Industry

20. Pre-war.—Unlike many Indian industries, the electrical industry came into existence in India a few years after the termination of the first World War. The necessity of building up this industry was felt much earlier, but lack of technical knowledge and enterprise, combined with restrictions on the import of capital goods and machinery during the first World War, precluded the industrialists of the country from entering into the field of this industry. Though later the growing sense of the rapidly increasing importance of the industry prevailed and steps were taken for its establishment, the industry's outlook was considerably narrowed by the dumping of cheap electrical goods from foreign countries like Japan and Germany.

21. Fan manufacturing industry with the establishment of a factory in Calcutta in 1921 became the pioneer electrical industry of the country. Since then half a dozen fan manufacturing factories have come into existence. In 1921 a factory for the manufacture of cable and wires was installed in Tata-nagar. The first lamp manufacturing factory was established in Calcutta in 1932 and since then eight more factories have been set up. Electric motor, transformer, insulator and battery manufacturing plants appeared long after. The output of the industries was extremely small, with the result that the country's major requirements had to be imported. Hence, before the II World War, the activities in regard to electrical machinery and equipment were confined mainly to trade. The fact that many foreign concerns established subsidiaries in India would indicate that there is field for considerable business, and with the schemes referred to at a later stage the volume should increase manifold. The foreign manufacturers have to their credit experience of long years in manufacture and special facilities in obtaining raw materials at lower costs through their connections in foreign countries. We are also aware that the control of prices of many raw materials rests in the hands of giant manufacturers who have hitherto followed a policy detrimental to the interest of

undeveloped countries.. Many of these foreign concerns have schemes to manufacture certain products in India and as the local industry develops, it will be necessary to consider to what extent the activities of foreign combines would need to be co-related and co-ordinated in order to prevent any adverse effect on the wholly national manufacturing firms.

22. War Period.—The development of fan, lamp, batteries and insulator industries made considerable advance during the last six years. Even prior to the fall of France when the tempo of war production was low, considerable activity had taken place in the manufacture of these products in the country. With the fall of France and the urgent necessity of meeting the increasing demands of the Armies in the Middle East, supplies had to be obtained from all branches of the industry whether large or small scale. With the entry of Japan into the War, steps had to be taken to import machinery and equipment for expanding the manufacture of the above specified four industries and such industries as electric motor, transformer and cable and wire. The production of fans, lamps, batteries and L.T. insulators reached a reasonably good standard of volume and quality in the country. A more determined assistance in making available raw materials, technique and capital goods to the industrialists would have undoubtedly advanced the industry further during the war.

23. Post-war.—The difficulties experienced by the industry during the war have still to be surmounted. Capital goods, raw materials and technique are not forthcoming sufficiently to enable rapid growth of the industry. With the fillip given to the few industries specified above, establishment of new industries such as radio, electrical instruments, refrigerator and air-conditioning have had the consideration of large concerns during the post-war period. With an assured and continuous supply of necessary raw materials and with the assistance of Government on the lines recommended in this Report, the Post-war output of fan, lamp, batteries and L.T. insulator industries should meet the requirements of the country and leave a surplus for export to the countries on the fringe of the Indian Ocean and the China Seas, replacing German and Japanese products, which are not likely to appear in the markets for some years to come. However, foremost attention should be paid to the development and establishment of heavy electrical industries, as the expansion of industries utilising electrical power will depend largely on supply of their requirements by the indigenous heavy electrical industries. In this category the items that will need special attention are motors, generators, transformers, electric cables of wire, switchgear and refrigeration and air-conditioning equipment.

24. Certain items under the category of light electrical industries are also of importance. Radio sets and equipment, for example, have tremendous educational value. Production of a cheap and efficient unit locally should be given special attention.

25. Certain feeder industries, such as electrical steel, insulating materials and drawn and covered conductors, which are dealt with in greater detail later on, are also of extreme importance for purposes of developing the industry.

26. The industrialists have ample capital at their disposal and there is every reason to believe that with necessary assistance from Government for importing capital goods, raw materials and technique, the electrical industry as a whole would be well-established during the next five years.

CHAPTER III

Post-War Developments

27. The post-war development of electrical machinery and equipment manufacturing industry is closely linked up with the development schemes at such Government Departments and industries as are likely to utilise electrical

products in considerable quantities. A survey of these plans is essential as the extent of their electrical requirements would greatly determine the prospects for the future electrical industry.

28. Electricity Generation.—The availability of electric supply has a considerable bearing on the development of electrical industries. The various Provincial Governments were addressed with a view to elicit information regarding the post-war development of electric supply in their Provinces but their response was very poor. At the suggestion of Mr. H. M. Mathews, Electrical Commissioner with the Government of India, a questionnaire was prepared, which with the reply received from his Office is re-produced in Appendix VI. Though the information furnished by that Office has its limitations, it affords a valuable basis for visualising the country's requirements of electrical equipment in the light of the position set forth below:

- (i) The Electrical Commissioner has furnished an analysis of electric energy generated in India during 1939. From this analysis which is given in Appendix VII, it will be observed that with the exception of Mysore, Delhi and Bombay, where the energy generated *per capita* was between 35 to 41 K. W. H., in all the other Provinces and States it was less than 10 K. W. H. *per capita*.
- (ii) Appendix VIII gives a comparison of the total installed capacity in 1939 and 1946 and estimates for 1953, 1958 and 1963. It will be noted that the anticipated expansion in generating capacity is quite large. In fact, the installed generating capacity in India in 1953 and 1963 is expected to be roughly two-and-a-half times and three-and-a-half times respectively of that in 1939.
- (iii) The cost of the additional generating plant likely to be installed by the end of 1953 on the basis of prices ruling in 1945-46 is expected to be Rs. 47 crores. Two-thirds of this cost would go towards the purchase of thermal electric plant and the balance towards the purchase of hydro-electric plant.
- (iv) In India, there are at present 408 public electric supply undertakings with their own generating stations; of these, 100 generate direct current supply, 298 generate standard alternating current 50 cycles supply and the other four undertakings generate non-standard alternating current 25, 40 and 60 cycles supply. Over and above these, 136 undertakings receive bulk supply, 7 of which have the central distribution operating on D.C. supply and extensions on A.C. supply and the remaining 129 undertakings operate on A.C. supply. The Electrical Commissioner's Office is adopting the policy of advising undertakings to limit additions or extensions of non-standard generating plant to the minimum and of encouraging the utilities concerned to change over to the standard alternating current 50 cycles supply. They anticipate that the connected load capacity in 1953 will be 3,920,000 Kilo-watts and of this quantity not more than 7.32 per cent. will be on direct current supply, not more than 1.4 per cent. on non-standard alternating current supply and the balance on standard 50 cycles alternating current supply.
- (v) In Appendix IX the Electrical Commissioner has given the actual and anticipated connected loads in the domestic and industrial categories. The figures provided in the Appendix indicate that the utility of electrical energy is expected to grow in the same proportion for all the categories during the years 1939-1963.

29. The Government of India have inaugurated the "Central Technical Power Board" comprising specialist engineers to advise on and plan new schemes of hydro-electric as well as thermal generating stations, and electric high tension transmission and interconnection of electric power systems. India has immense hydro-electric power resources. Out of a potential of about 27 million Horse Power, the power actually developed is only about 3 per cent. The Central Technical Power Board is engaged on the planning of multi-purpose development of the Damodar river and on the studies of transmission grid developments in Bihar, U.P. and Punjab. The Central Waterways Irrigation and Navigation Commission are understood to be planning the development of power resources on the Kosi and Mahanadi rivers. Various Provincial Governments and Indian States have in hand plans for development of power from rivers such as Koyna, Godavari, Sutlaj, Rihand and Poringal-kuthu in Cochin. The power stations on these rivers would be interconnected with the existing hydro-electric and thermal stations. This would enable both hydro and thermal power to be utilised to the fullest advantage of each region.

30. Large electric power systems are not economical to develop unless an appreciable amount of remunerative load can be connected to the system from commencement of supply. On the other hand, rural electrification is essential for improving the economic standard of the agriculturist. Under existing conditions it would take a period of 3 to 5 years before rural loads can be developed sufficiently to make the rural electrification scheme economical. The Governments of Bombay and Central Provinces are, therefore, actively planning "Nursery Power Schemes", which comprise of a small power station with a capacity of 200/300 K.W. with a number of 11 K.V. distribution lines energising the surrounding villages and small towns. The "Nursery Power Schemes" will in course of time be connected to a high tension transmission grid, if within a reasonable distance, or to a large power station constructed for feeding a number of areas developed by means of the Nursery Schemes.

31. The rate of growth of the generating capacity may be taken as an approximate measure of the likely growth in demand for electric power consuming devices. The availability of electrical energy at economic rates would further augment the growth of this demand.

32. **Indian Posts and Telegraphs Department.**—The Indian Posts and Telegraphs Department, have proposed expansion of the various branches under their purview. Schemes under their consideration are outlined below.

33. **Telecommunications Development Scheme.**—During the war a large expansion of the tele-communications system in India was carried out to meet the operational and administrative needs. This scheme involved the construction of new main telegraph and trunk telephone lines between important centres in India, the installation of a long-distance telephone and telegraph equipment, the construction of subsidiary lines and installation of apparatus for secondary war centres involving a cost of Rs. 16.5 crores. This was subsequently reduced to Rs. 15 crores. It is estimated that the P. & T. Department, will take over Telecommunication Development Scheme lines and equipment from the War Department and carry out some new line constructions and equipment installations costing in all about Rs. 12 crores to form the main long-distance telephone and telegraph network for post-war development. In addition to the P. & T. main network circuits included in the Telecommunications Development Scheme, it is proposed to provide in the post-war period a more comprehensive network of 18-channel voice-frequency telegraph systems between the main communication centres in India, with 6-channel voice frequency telegraph systems joining the secondary centres to the main centres, so as to relieve congestion and reduce delays. The cost of this voice-frequency telegraph network will be approximately Rs. 23 lakhs. The telegraph network of the P. & T. Department, contains 64 Departmental Telegraph Offices and 4,062

Combined Post and Telegraph Offices with 107,000 miles of post routes carrying 616,400 miles of wire. In addition, the public has telegraph facilities available from 5,310 Railway Licensed Telegraph Offices. It is now proposed that there should be a telegraph office at all places with a population of 5,000 and over. There are about 3,800 such places in India, of which 2,300 are already provided with telegraph offices leaving 1,500 to be dealt with.

34. Expansion of Teleprinter Working.—It is proposed to make wide use of teleprinters in departmental telegraph offices as a step towards quickening and improving the existing service, in both the main and the secondary networks. The estimated cost involved would be approximately Rs. 45 lakhs.

35. Pre-war Telephone Network and Future Programme.—The Department operates some 400 exchanges with about 120,000 telephones. For a country of the size and population of India the telephone service is still very undeveloped and the number of telephones per head of population is very small. The following figures illustrate the position in other countries.

	Number of telephone per 100 population
British India	0.02 (on 31-3-39)
China	0.04 (on 1-1-39)
South Africa	2.03 (on 31-3-39)
Great Britain & Northern Ireland .	6.77 (on 1-1-39)
Australia	9.14 (on 30-6-39)
Canada	12.13 (on 1-1-39)
U. S. A.	15.37 (on 1-1-39)

The post-war programme of the Department will cover a considerable increase in the main and secondary trunk networks, telephone exchange systems and telephone exchanges.

In the post-war plan it is proposed to provide a telephone exchange in all towns with a population of more than 30,000. There are about 450 such towns in India and 300 of these are already provided with telephone facilities. Thus 150 new telephone exchanges with an initial capacity for 100 subscribers extensible to 500 are likely to be installed. Besides these new exchanges, the P. & T. Department, have provided for the replacement of the existing manual exchanges by automatic in medium sized towns and the expansion of the existing automatic exchanges in larger towns. Provision is already included for replacement of the Calcutta manual telephone system by automatic system and for expanding the automatic systems in Madras, Bombay, Ahmedabad and Karachi. The approximate cost of automatic plant which will be required during the next 10 years is Rs. 4 crores.

36. Air-conditioning.—The delicate equipment used in telephone exchanges and in carrier system installations has, for efficient working, to be kept scrupulously clean and preferably at an even temperature and humidity. It has, therefore, been proposed to have air-conditioning plants in medium and large size exchanges and repeater stations at a cost of Rs. 28 lakhs.

37. Wireless Service.—The post-war plan of the P. & T. Department provides for the development of wireless services for telecommunications purposes. At this stage it has not been possible to estimate the exact needs but a provision of Rs. 7 lakhs has been proposed to meet the initial requirements.

38. Line Stores.—The policy of the Department is to continue to manufacture its requirements of line stores as in pre-war days. The capacity for line stores manufacture developed in the P. & T. Workshops during the war amounted to an increase of about 50 per cent. over the pre-war capacity and by working overtime and night shifts the outturn of line stores was increased to nearly double that of the pre-war period. The increased capacity for manu-

facture will probably be required in full to meet the needs of post-war development.

39. **Equipment.**—With regard to telephone exchange and telegraph office equipment, there are certain items which the Department is not in a position to manufacture. It would, for instance, not be an economical proposition for the Department to make any attempt to manufacture its comparatively small requirements of automatic telephone exchange or carrier equipment which require not only a very high standard of engineering and expensive machinery but also continual and costly research. The same applies to the more complicated types of high speed telegraph apparatus. It will, therefore, be the policy of the Department as regards indoor equipment to restrict manufacture in its own workshops to its requirements of manual exchange equipment subscribers telephone sets, and the simpler types of telegraph apparatus as in the pre-war period.

40. **Railway Department.**—The Railway Department have formulated plans for considerable development costing several crores of rupees during the next fifteen years. As various members of the Panel represented to the Chairman that despite repeated efforts, they had failed to elicit any information in respects of the requirements of the Railways, the Chairman addressed the Chief Commissioner for Railways requesting him to intimate the annual report of the requirements of the Railways, the Chairman addressed the ment. The Panel, however, records with regret that upto the time of writing the Report, the information had not been received. It is unfortunate that one of the principal Departments of the Government vitally concerned with the industry of the country should have deemed fit to keep silent on this all important question affecting the indigenous electrical industries. In the circumstances the Panel had no alternative but to rely on information obtained from other sources.

41. We reproduce below a statement relating to the Railway electrification projects under examination of the Railway Board:—

Railway	Section proposed for electrification	Mileage of Section
		Miles
Bombay, Baroda & Central India Railway.	Bombay Ahmedabad . . .	270
Great Indian Peninsula Railway	Igatpur-Bhusaval . . .	191
	Poona-Dhond . . .	48
	Dhond-Manmad . . .	146
East Indian Railway . . .	Howrah-Gaya-Moghalserai } Howrah-Bandel-Burdwan . }	444
South Indian Railway . . .	Tambaram-Villupuram . . .	83
	Chingleput-Arkonam . . .	39
Bengal Assam Railway . . .	Calcutta-Ranaghat . . .	46
	Calcutta-Bongaon . . .	48
	Southern-Section . . .	37
	Total . . .	1,352

The E. I. Railway scheme for electrification from Howrah to Moghalserai is likely to be given first priority. The E. I. Railway have already instituted a general project survey and have been instructed to prepare detailed project in consultation with their consulting engineers.

42. It is understood that the Railway Board are not sure of adequate return on capital outlay on thermal power stations for electrification purposes. There already is a widespread public protest over the question of wasting useful coal assets by the Railways, and quite apart from this, the fact remains that the electrical industry, particularly the heavy electrical together with manufacture of prime movers in the country have to be developed. Local availability of technical advice, for which the Railway Board at present depend on foreign experts, is emphasised in this Report. These factors should in course of time considerably reduce the Railway Board present estimates for initial costs and maintenance. The Panel are firmly of the opinion that rapid electrification of the Railways will provide a considerable impetus to the local industries and the approach to the subject should therefore not be purely from the point of view of the Railway revenues.

43. The Panel note with satisfaction the announcements made by the Government in regard to the post-war Railway expansion schemes. The proposals to instal railway carriage fans in all third class compartments will enhance considerably the demand for 24 volt D.C. fans. Increasing popularity of air-conditioned compartments will necessitate the building of more air-conditioned coaches, which again works on 24 volt D.C. circuit. The proposed expansion of railway facilities over the next 10 years added to the previously stated requirements will make the volume of requirements of such electrical equipment as fans, train-lighting lamps, batteries, generators, switchgear, wires and electric fittings for the Railways very large. The Railways should be in a better position than other Departments to standardise the requirements and publish a classified list for the benefit of the electrical industry as we have stated elsewhere.

44. **Expansion of Cotton Textile Industry.**—In February 1945, the Government of India appointed a Committee to prepare a plan for the development of the Indian cotton textile industry. The Government have since then accepted with some minor modifications the detailed suggestions of the Committee for the allocation of new spindles for the various zones. Appendix X shows the detailed allocation then decided upon.

45. The Honourable Member for Industries and Supplies has since stated in the Legislative Assembly that one hundred and twenty-five new cotton textile mills were proposed to be erected in India.

“The proposed mills had been distributed as follows: Bombay 24 (352,000 spindles); Madras 16 (325,000 spindles); Bengal 12 (264,000 spindles); U. P. 15 (437,000 spindles); Punjab 9 (213,088 spindles); Bihar 6 (151,000 spindles); C. P. and Berar 4 (119,000 spindles); Orissa 3 (75,000 spindles); Sind 4 (100,000 spindles); States 32 (708,800 spindles). The number of the existing mills was 417.”

46. The Indian Coalfields' Committee have in their recommendations stated that the cotton textile mills, particularly those in and about Ahmedabad, should be converted to furnace oil instead of coal with a view to economise the coal resources of the country. It is further stated that such conversion will be Rs. 4-8-0 per ton of fuel costlier to the industry, owing to which the industry is reluctant to adopt this suggestion. Cheap hydro-electric power is the simplest solution and Government should pay special attention to making it available to large industries such as the textile industry as early as possible.

47. It is not possible to state with certainty that all the 125 new cotton textile mills will be equipped electrically but assuming that it will be the case their requirements may be estimated from the following particulars.

48. Power required for driving the various machinery installed in the above two types of mills on individual and group drive basis and number of motors required therefor are indicated in Appendix XI.

49. From the various sections given in the Appendix, it will be observed that if individual drive on all machines is contemplated a total of 156,461 motors of different capacities will be required. On the other hand if group drive, as at present existing in several mills, is adopted a total of 27,451 motors will be required. To these, 10 per cent. will have to be added to meet the demands of motors for Auxiliaries, Humidification and Air-conditioning plants. In this connection it may be noted that the modern trend of mill engineers is to change over from obsolete group drive to individual drive for better efficiency in Spinning Intermediate and Roving Departments and in Blow Room.

50. Electrical energy requirements would be of the order of approximately 600,000 K.V.A. High tension and low tension switchgear would be required in proportion to the number of motors and transformers installed. Approximately $3\frac{1}{4}$ million yards with individual drive or 600,000 yards with group drive of rubber insulated cables would be required for these mills.

51. The above figures are a rough estimate and will require modifications in the light of such factors as the type and class of machinery used and the type of electrical energy available. The electrical industry would in any case need to watch the progress of construction of the textile mills in different areas to obtain correct estimates of the requirements from time to time.

52. **Automatic Industry.**—Automobile manufacturers in foreign countries generally buy a large proportion of the components of vehicles from specialised manufacturers either in the finished or in the semi-finished state. In regard to electrical components such as dynamos, starters, distributor assemblies, wiring, lamps etc., either the complete set or at least the important components are purchased from specialists such as Lucas, Delco-Remy, Bosch etc. Even the complete wiring is fabricated into a 'harness' for each type or model in accordance with the automobile manufacturers' design, so that it is mounted on the chassis in the state received from the electrical component manufacturers.

53. It is difficult to state at this stage as to what the attitude and policy of the two pioneer automobile manufacturing concerns in India will be in regard to purchase of the electrical components for the vehicles that they will manufacture. The earlier stages of their operations will be confined to assembly of vehicles for which the components will be purchased from foreign manufacturers in the finished state, as the designs of vehicles have also been purchased under the arrangements agreed to with the foreign manufacturers. However, both the pioneer concerns have plans to develop local manufacture to maximum possible extent as and when facilities for local manufacture of components develop. It is a matter of common knowledge that automobile components are highly specialised items of manufacture. For instance the self-regulating dynamo developed during the last few years adds greatly to the convenience of the car owner, as the rate of charge of dynamo is automatically increased when the battery charge drops low. Again, the components of the distributor assembly are small in size and operate at high revolutions. The voltage in the circuit being also high, the entire design and manufacture is of specialised nature.

54. There being no manufacture of automobile at present nor prospects of its developing in the near future, it should be possible for the electrical industry, by contact with the automobile manufacturers, to develop the manufacture step by step of the electrical components of an automobile in co-ordination with automobile industry. On a reference to the Automobile and

Tractor Panel, it is learnt that this Panel has emphasised the local manufacture of vehicle components for which facilities develop in the country, and the automobile industrialists have been made greatly responsible for assisting the development of local manufacture of such components as can be obtained to proper standards of quality.

55. Agriculture.—We have, in the introduction to the report, referred generally to the benefits resulting from electrification and cheaper supply of refrigeration and air-conditioning equipment to agriculture. A number of concerns have already announced schemes for the storage and/or manufacture of seed-potatoes, fruits, fruit syrups and juices etc. There is no indication so far of the commercial interests in India attempting to improve and increase the milk output of the country. However, the fact remains that in accordance with the "Memorandum on the Development of Agriculture and Animal Husbandry in India of the Advisory Board of the Imperial Council of Agriculture and Research, 1944", the fruit and milk production of the country needs to be increased by 50 per cent. and 300 per cent. respectively to achieve the minimum nutritional requirements of the present population. One of the essentials, as regards increasing the production of the country in these two items alone, would be to provide extensive facilities for cold storage to reduce wastes. The economic and labour conditions in the country would further tend to increase the demand for domestic refrigeration. The electrical industry in India, therefore, has before it the prospect of a considerably increased volume of trade if it undertakes to supply cheap and efficient equipment for the purposes mentioned.

56. We have chosen to emphasise two important aspects but the World food shortage conditions prevailing for a number of years and expected to continue for a long period still, would undoubtedly impress on the Indian industry the necessity of providing various other electrical machinery and equipment such as motors for pump units for irrigation and relating equipment, and portable generating equipment, etc., at an economical price.

57. Air-conditioning.—Before the war, air-conditioning equipment cost was so prohibitive that the necessity of installing such equipment owing to the climatic conditions prevailing in the country was not generally appreciated. The strain of work during war has given an impetus to the popularity of such equipment despite its prohibitive costs. Although the stage has not yet come when it can be confidently stated that air-conditioning equipment is in common demand, there is no denying that with cheap and efficient units made available freely its popularity will rapidly increase. It is not an industry that stands as a unit by itself, but is generally undertaken as a co-ordinated manufacture. The compressors, for example, are purchased from specialists, ferrous and non-ferrous tubes, wiring, motors and gas, etc., are also purchased likewise, and manufacturers of air-conditioning equipment concentrate on the design, fabrication and assembly of the components and the body. The local industry should be able to develop manufacture in co-ordination with foreign interests, which may be given a minor financial interest in the local subsidiary, as rapid strides have been made in foreign countries in evolving a highly efficient and comparatively cheap unit for this purpose.

58. Other Developments.—At an earlier stage under the heading of "Introduction", we have already emphasised the extensive utility of electricity and its machinery and equipment in various developments expected in the country. The most important factor to be borne in mind in regard to other developments is the development of cottage industries, which should receive the serious attention of the Government owing to its importance in increasing the purchasing power of an agricultural country like India. There is no doubt that Government will play an important role in such development but it is incumbent on the local industries to provide the initiative by bringing

out cheap and useful mechanical tools and equipment to assist the village craftsmen, who have in the past played a useful role in the economy of the country. In this respect it is worth quoting the example of Japan in developing cottage industries, which depended to a great extent on cheap and ready availability of electricity and electrical tools and equipment.

59. Owing to increased cost of labour, various industries such as sugar, paper manufacture, chemicals, etc., would need to utilise increasingly conveyor systems and other labour saving devices. Inadequate transport facilities and labour shortages will give an impetus to the use of cranes, hoists, etc., operated by electricity where electric current is cheap and readily available. The indigenous electrical industry, therefore, has the field and opportunity to increase popularity of such equipments, by making available cheap and efficient units.

CHAPTER IV

AVAILABILITY OF RAW MATERIALS

60. We have found it essential to emphasise the aspect of availability of raw material, as by a glance at the list of raw materials required by the industry the impression might be created that the industry is in an advantageous position in this respect. Whilst a number of items of raw material may be available in the natural state, the benefit will not accrue to the industry until and unless necessary processing facilities are established in the country. In foreign countries the processing facilities are not a part of the manufacture of electrical apparatus, though such manufacturers contribute to a very large extent to research by active participation or financial assistance. The Indian industry is to make up for lost time and have to ensure proper quality products. In view of this consideration we have in a later chapter emphasised the necessity of facilities for higher technical education and research being rapidly developed. A review of the position regarding availability of materials in this chapter will no doubt make clear the necessity and advantage to the industry in particular and the country in general in developing raw material sources and processing facilities to the maximum possible extent. The latter need not necessarily be limited in its output to the requirements of the industry, as with proper development of processing facilities, it may be possible to export processed raw materials to foreign countries with corresponding benefits to the country at large.

61. **Copper.**—Copper pyrites is a principal ore of copper and is widely met with in India. The ore is available in Khetri and other places in Jaipur State, Singhbhum and Barabunda (near Parasnath Hills), Sikkim State, Kumaon and Kangra Valley in the Himalayas and in the Mysore State. But in view of lack of concentration of copper pyrites in these mines the resources of India in this mineral on the whole may be considered poor. Only one mining concern in Singhbhum to-day produces about 6,000 tons of copper annually by treating about 850,000 tons of this ore, the copper content of which is about 2.5 per cent. They are manufacturers of hot rolled brass sheets rather than of copper since they are unable to compete with imported copper. They are able to compete successfully in the field of brass sheets owing to tariff protection and duty free import of zinc. So far as the electrical industry is concerned, no electrolytic copper is being produced in the country. Government should undertake extensive survey as the copper output in the country is far below the market's requirements and with the increased industrial development the shortage will be much more. The Panel is of the opinion that at least a portion of the locally available copper should be set aside for the requirements of the electrical industry and processing facilities for producing electrolytic copper developed. The production of electrolytic copper out of copper alloy scrap is possible and should be encouraged by the Government

by lifting all import duties on copper scrap and if necessary giving a subsidy to the indigenous producers of electrolytic copper.

62. Iron and Steel.—Large quantities of pig iron in the form of casting are required by the electrical industry. It generally obtains its supply of castings from specialists in the line though in some cases in India the electrical manufacturers have their own foundries. Castings produced in the country have in the past not been to required standards of quality except those made by a few foundries. The need for better class foundries in different centres of India for satisfying the demands of the electrical industry is emphasised. Pig iron for manufacture of castings is available in sufficient quantities in India but the prices have not been actuated by any planned economy for the industrial development of the country as will be readily seen on a comparison of pre-war export prices with the prices for local consumption.

63. Steel for shaftings can without difficulty be obtained to required specification from the steel producers. They normally supply it in the form of bars and sections which need to be forged, shaped and/or treated. Forging facilities are at present lacking in the country but are bound to develop, as the demand for such products will achieve increasing importance with the development of various industries. Some heat treating processes such as annealing is undertaken by steel producers. Machining, tempering, etc., is done by firms undertaking forging. The electrical industry would therefore not need to develop this as a part of their organization but should explore possibilities of other firms established in the trade equipping themselves to meet the requirements of the electrical industry.

64. Electrical Steel.—The sole present indigenous source of electrical sheet is India's leading steel company, but their present capacity is limited and is stated to be approximately 2,000 tons per annum of electrical steel sheets of different grades.

65. Whilst this may be regarded as a good start, it is inadequate for the basic requirements of the electrical manufacturing industry as it is calculated that approximately 10,000 tons of electrical sheets per annum are required for the first five year period and 20,000 tons for the second five year period.

66. It appears, therefore, that further development is most urgently required as imports of electrical sheet are almost impossible to obtain due to world steel shortages except perhaps by firms with long standing contacts.

67. It is also important that the quality of the electrical sheet steel supply to the industry should be uniform and comply with the standards required for this purpose.

68. The necessary testing equipment to achieve this uniformity of product has still to arrive at the Steel Company's Works, but with the expansion in quantity and improvement in quality suggested above India's requirements of electrical sheet steel could be met from within India's own resources.

69. Constant complaint has been made by the electrical manufacturing industry that there is only one source of supply in India for the finished electrical stampings and that this stamping firm can neither supply the quantity required nor at a reasonable price.

70. The question of quantity would appear to be tied up with the world shortage of electrical sheet combined with the stamping capacity available with the firm in question. "The position would be remedied if the Government were to take positive action to get the existing Indian source of supply of electrical sheets to increase its output or to create new sources of supply in accordance with the requirements of the Industry since individual electrical manufacturing firms generally have their own stamping presses which can produce the finished stampings required by them"

71. Under improved conditions of supply complaint in the matter of prices should also disappear.

72. **Rubber.**—The rubber output of the country being small, it has not, in the past, been in demand by tyre manufacturers, particularly those in America, as they have concentrated on bigger sources, such as Malaya and Dutch East Indies. So far as is known to us, the quality of Indian rubber would be suitable after necessary processing for use by the electrical industry. The handicap however is in regard to processing, which with the assistance of the Council of Scientific and Industrial Research should be satisfactorily developed. From the economic aspect also this would be a welcome course of action, as it would give a fillip to that industry.

73. **Mica.**—India is world's biggest mica producer. In the past the mining interests have concentrated on exports. Selection and grading of mica at source is an essential factor that so far has been neglected by the industry. The scope of the Government Inspection Departments can be widened so as to lay down proper standards of grade and quality for supply to the electrical industry. It is worth mentioning in this connection that similar steps taken by Government in respect of steel industry has enabled the public to obtain supplies of suitable quality steel certified by the Metallurgical Inspectorate attached to certain producers.

It is unfortunate however that so far no attempt has been made to produce micanite insulating materials. Establishment of an up-to-date factory for the manufacture of all types and kinds of micanite insulating products should have the immediate consideration of the Government. It is considered that the factory will not only be able to supply the needs of India but will be in an advantageous position to export the finished products to all parts of the world provided the products are manufactured to international standards.

74. **Shellac.**—Shellac is available in large quantities and exported. But, as in the case of mica, no processing facilities have been developed for manufacture of varnishes, etc., required by the electrical industry. As this is an important insulating material the establishment of shellac varnish industry is strongly emphasised. Here again the Council of Scientific and Industrial Research and the Lac Research Institute can render useful assistance.

75. **Cotton and Silk.**—Indian cotton and silk industry should be able to provide all the requirements of yarn, tape and fabric needed for the manufacture of insulating yarn in wire covering, insulating tapes and cloths. Specifications will however have to be drawn up by the proposed National Physical Laboratory for India to assist the silk and cotton mills to produce yarn, tape and fabric to correct standards. If the mills are unable to produce them to the required standards with the existing equipment, facilities should be afforded to them to import suitable machinery. With the availability of tape and fabric, factories should be established for the manufacture of insulating tapes and insulating cloths.

76. **Porcelain.**—This industry is at present in very elementary stages of development for purposes of high tension insulators, though in respect of low tension insulators considerable impetus to improve quality has been given as a result of war demand. Owing to handicaps of local availability and costs of certain raw materials required for purposes of processing, such as quartz and felspar, the porcelain industry has not yet achieved desired standards of quality and output. We suggest that the Council of Scientific and Industrial Research should make necessary investigations and recommendations to assist the porcelain industry.

77. **Plastics.**—The plastic industry has developed in foreign countries rapidly and the products are assuming such extensive usage that it may soon displace rubber, mica, shellac, cotton and silk and even porcelain, owing to

the advantage in shaping and forming on mass scale. Nylon is already being used for insulating wires instead of rubber, cotton, silk or enamel and it is reported that not only are better insulating properties achieved but that the manufacturing costs are lower. The indigenous bakelite industry should keep abreast of development in foreign countries, in which Government assistance is important. It should adopt new methods and processes for the benefit of electrical industries.

78. Insulation Oil.—Insulating oil is a highly specialised product that will be needed very extensively in the country as the hydro-electric schemes take shape. It is used in transformers and switchgear operating at high voltage. The base for this is mineral oils. Mineral oils are available in the country but it is not known whether the quality is suitable for the manufacture of high grade insulating oils. The Bangalore Institute of Science have done considerable original work in regard to hydro-electricity and should undertake further research on this subject also. It is understood from the representative of Travancore Government that oil from cashewnut shell has been found a very satisfactory medium for making insulating oil and varnishes. The State are installing plant for increased recovery of cashew shell oil and are also studying the question of providing necessary processing facilities. The representative anticipated that in course of time it should be possible to meet the entire requirements of the country in insulating oil from local sources provided extraction and processing facilities are established in the country. This question is of extreme importance to the Industry and Government should provide all the assistance possible in the connected investigations.

79. Imported Items.—Imported items for purposes of the electrical industry consist mainly of items like ball bearings, roller bearings, machine screws, press-pahn sheets, synthetic plastic varnishes and enamel etc. One company has been floated in India for the purpose of manufacturing ball and roller bearings. The American specialists, Messrs. Ford, Bacon and Davis have in their report mentioned that the Muradnagar Ordnance Factory can by additions and alterations to existing equipment be utilised for manufacture of ball and roller bearings. They have also recommended that the ball and roller bearing plant allotted to India under the "Reparations" scheme should be brought out for this purpose. However, it is not possible at this stage to state whether local manufacture is likely to develop in the near future. It is assumed that owing to the importance of ball and roller bearings for development of manufacture of electrical machinery, automobile, etc., the Panel concerned will make adequate recommendations to establish this industry. Until the industry is established, the electrical industry would need to import ball and roller bearings required for its purpose. This Panel holds the view that items of this nature, that are of general importance for development of local industry, should be imported into the country free of customs duty, till such time that local manufacture could start.

80. Quite a number of plants for the manufacture of nuts, bolts, machine screws, etc., are being installed and if the indigenous electrical industry would contact interests concerned it should be possible to make arrangements for obtaining their requirements from local sources.

81. Press-pahn paper is a highly specialised product and at present it is being imported. India has the facilities to manufacture high grade paper and since it is mainly a question of imparting required properties to the paper it is suggested that the Council of Scientific and Industrial Research and the Industrial Panel for Paper should pay special attention to the development of this widely used insulating material.

82. Before concluding this Chapter it is essential to emphasise the shortage of two vital raw materials, viz., electrical steel sheet and electrolytic copper which are at present badly needed by the electrical industry of the country. The Panel is given to understand that there is practically an embargo on the export of these two vital materials from U.S.A. and England. Till such time as they are produced in the country in sufficient quantities, the Government should assist the indigenous electrical industries by obtaining them from foreign countries by suitable trade agreements. Since India is a principal exporter of mica, shellac, manganese and chrome, Government might consider the advisability of bartering arrangements for supply of electrolytic copper and electrical steel sheets.

CHAPTER V

PROPOSAL

83. It has been necessary in our recommendation to give a picture of pre-war position of manufacture and imports, likely post-war demand for a five year period, and the post-war position of manufacture in India. In the estimates for the post-war demands, we have indicated estimates for the second and third stages of development wherever possible. These estimates will need revision from time to time in the light of future industrial developments.

84. The targets for manufacture have been given where possible for all three periods of development, but the figures for the second and third periods may need alterations in the light of industrial development and experience gained by the industry during the first quinquennium period.

85. In our recommendation the capital costs are based on present day costs of capital goods, buildings, land etc. Adjustments would therefore need to be made in accordance with future fluctuations.

86. The requirements of capital goods for the first period of development would mostly need to be imported, but during the second and third periods, with the growth of machine tool industry in India, a considerable quantity may be available from local sources.

87. The question of availability of raw materials, tariff and location has been mentioned to cover individual requirements in respect of the particular item.

88. *Heavy Electrical Industries.*—We have previously emphasised the need for giving foremost consideration to the development of heavy electrical industries. A number of commercial interests have plans for expansion or new installation for manufacture of machinery and equipment of higher capacities. Negotiations are in train with foreign countries for manufacture of several new and improved types of equipment. The next fifteen years would see considerable development of the heavy electrical industries by commercial interests. Whilst the Panel have in their recommendations for establishment of manufacture of primary power equipment given due regard to the increased requirements of the country as a result of the various development schemes, we wish to draw the close attention of the Government to the fact that the manufacture of primary power equipment such as alternators, generators and transformers even of large capacity should be accelerated. It is visualised as very likely that the country's requirements may be far in excess of the estimates given in the report if all the development schemes make rapid progress in the next few years. At present imports are difficult to obtain and it would not be desirable to hold up schemes on that account. A big effort is needed to establish the industry on a large scale.

89. *Motors and Generators.*—(i) At present the manufacture is mainly restricted to that of from 1 to 10 H.P. alternating current squirrel-cage

motors, but the manufacture of other types and sizes of motors is contemplated by Indian manufacturers. The pre-war capacity for the manufacture of these motors of approximately 2,000 nos. per annum has now increased to approximately 20,000 nos. The average annual import of motors during the five years preceding the Second World War was approximately Rs. 38 lakhs representing roughly 30,000 nos. However, with the rapid development of electrification and industries consuming electrical energy, the demand for motors will be very considerable and constantly increasing.

(ii) The following Table gives approximate figures of imports in 1939, expected annual demand during next five years, present manufacturing capacity and the targets to be aimed at by the industry during the next five, ten and fifteen years. It may be noted that no figures have been given or recommendations made in respect of Direct Current motors and generators, as the demand for these motors and generators is small. The Panel consider that the manufacture of these motors and generators may be left to the manufacturers of alternating current motors and generators, who will develop the manufacture of direct current motors and generators if the demand justifies the same.

TABLE

	A. C. 3-phase slip-ring motors	A. C. Fractional Horse Power Motors	A. C. 3-phase Squirrel Cage Motor	A. C. Motor Starters	A. C Generators
	Nos.	Nos.	Nos.	Nos.	Nos.
Approximate imports in 1939.	1,500	3,000	24,500	20,000	2,000
Estimated annual demand during next five years.	4,500	18,000	75,000	60,000	4,000
Present manufacturing capacity per annum.	Nil.	Nil.	7,500	Nil.	Nil.
<i>Stage I—</i>					
Target for manufacture per annum during the 1st five years ending 1951.	1,000	3,000	35,000	40,000	1,000
<i>Stage II—</i>					
Target for manufacture per annum during the next five years ending 1956.	2,000	7,000	75,000	60,000	2,000
<i>Stage III—</i>					
Target for manufacture per annum during the third five years ending 1961.	Entire requirements of the country.				

(iii) During the first stage of manufacture the country should manufacture fractional H.P. motors and 3-phase induction motors upto 25 H.P. capacity only, (as the demand for motors of higher capacity would be limited), and

A.C. generators upto 50 K.V.A. During the second stage, manufacture of A.C. motors and generators upto a capacity of 100 H.P. and 100 K.V.A. respectively should be undertaken. During the third stage, motors and generators of all types and sizes should be manufactured.

(iv) A capital of Rs. 2½ crores and capital goods of value of Rs. 1 crore would be required for the production of motors, etc., specified under Stage I. Out of Rs. 1 crore worth of machinery, nearly Rs. 25 lakhs worth is already installed. Of the remaining Rs. 75 lakhs, equipment costing Rs. 60 lakhs would require to be imported and the rest could be obtained from Indian sources.

(v) Raw materials used by this industry primarily consist of electrical steel, electrolytic copper insulated wires and strips, C.I. castings, mild steel rods, ball and roller bearings and insulating material. Of these, to some extent electrical sheets and wires and entire insulating materials have to be imported. The manufacture of electrical sheets and wires has been commenced in the country and they should be available in volume to the industry during the next five years.

(vi) The existing import duty on a considerable part of the raw materials and components used by the industry is higher than that imposed on the finished product. The import duties on copper winding wires and electrical steel punchings are 24 per cent. and 12 per cent. respectively and that on sundry hardware, ball and roller bearings, insulation (solid) and insulation (liquid) is 30 per cent., whereas it is 10 per cent. on imported motors. This has resulted in the cost of imported materials used in the manufacture of motors in India being approximately 18 per cent. higher than similar materials used in the manufacture of the imported motors. The total cost of all materials used in the manufacture of motors is correspondingly increased by approximately 12 per cent. in comparison to the cost of materials used in the imported product. This implies a serious handicap to Indian industry when competing with the imported product and it is recommended that this anomaly be immediately removed by reducing the duty on the above specified materials to the same level as that on the imported finished products.

(vii) At present motor manufacturing factories are established in Calcutta, Bombay, Lahore, Kirloskarvadi and Coimbatore. With the extension of manufacture recommended in this report, establishment of additional factories at Bombay, Calcutta and Lahore and new factories at Madras, Bangalore, Tatanagar and Cawnpore should be considered. Generally speaking, the aim in regard to the manufacture of these items should not be concentrated volume. As facilities for electrical power become more and more extensive, the manufacture of these articles can also be spread extensively over the country; for example, factories can be established with advantage in N. W. F. P., Sind and Assam. In fact a stage may come, as these developments take proper shape, when in the interests of development of agriculture and cottage industry a widespread manufacturing scheme may become necessary. It is premature to make specific recommendations on the subject but it should receive the serious attention of the Provincial Governments in co-ordination with their schemes for expansion of agriculture, cottage industry and electricity distribution.

90. Transformers.—(i) The range of transformers manufactured in India covers small low tension lighting transformers upto distribution transformers of 500 K.V.A. rating and 22 K.V. on the high tension side. Only a limited number of 500 K.V.A. transformers have been manufactured and the bulk of the production, apart from the very small low voltage transformers, has been in the range of 25 K.V.A. to 100 K.V.A. and upto 11 K.V. on the high tension side. These types of transformers are used in large quantities by supply undertakings when energy has to be transmitted over long distances at a high voltage and reduced to a lower voltage at the consuming end. The pre-war

capacity for the manufacture of transformers was approximately 6,000 K.V.A. per annum. The present capacity is approximately 80,000 K.V.A. per annum, but owing to difficulties in securing raw materials it is not being fully utilised. During the five years preceding the last War the annual import of transformers was approximately Rs. 19 lakhs representing approximately 150,000 K.V.A. The post-war demand, with the contemplated increase in generating capacity and the distribution of electricity over wide areas, will be large. The annual requirements of the country in the next five years are estimated at 300,000 K.V.A. A very large portion of this would be in the range of 25 to 500 K.V.A. and voltages upto 11 K.V.

(ii) The targets to be aimed at by the industry are given in the following statement.

	Capacity upto	Manufacture per annum
<i>Stage I.</i> —Target for manufacture per annum during the first five years ending 1951.	500 K. V. A. suitable for a voltage upto 11 K. V.	2,50,000 K. V. A.
<i>Stage II.</i> —Target for manufacture per annum during the second five years ending 1956.	5,000 K. V. A. suitable for a voltage upto 66 K. V.	500,000 K. V. A.
<i>Stage III.</i> —Target for manufacture per annum during the third five years ending 1961.	15,000 K. V. A. suitable for a voltage upto 132 K. V.	Complete requirements of the country.

(iii) During Stage I, the manufacture of large power transformers in the country would be uneconomical as the demand is small considering the capital costs of the manufacturing plant required for the purpose, and the Indian manufacturers having only recently started the manufacture of transformers lack necessary technique and experience. Hence, at least for the next five years or so, it will be necessary to import large power transformers. Thereafter, the existing factories should be able to take up the manufacture of these transformers and in about 15 years' time there should be no necessity for importing transformers into the country.

(iv) Capital required for the development of the industry during stage I would be small, as the manufacture of transformers would generally be undertaken by the manufacturers of motors and generators. It is estimated that capital goods of value not exceeding Rs. 10 lakhs would need to be imported.

(v) With the development normally expected in respect of this industry, the value of capital and capital goods required during Stages II and III will be insignificant.

(vi) Of the raw materials required in the manufacture of transformers, insulated copper conductors, cast iron cable boxes, mild steel sheets and low tension porcelain insulators and bushings are manufactured in the country, whereas silicon steel laminations, steel tubes, insulating materials and high tension porcelain insulators have to be imported to a considerable extent. Steps for the local production of these imported raw materials, with the exception of insulating materials, have been taken and in the course of next five years the need for import of these should be reduced.

(vii) The position in regard to import duty on transformers is similar to that in respect of electrical motors, i.e., the duties on raw materials are higher than on the finished goods, which is detrimental to development of industries.

(viii) The transformer manufacturers are at present located in Calcutta, Bombay, Lahore and Bangalore. Manufacture of transformers is generally combined with that of motors and generators and future expansion of the industry would naturally follow that of electrical motors and generators.

(ix) The actual process of manufacture of static condensers is very specialized and carried out in special air-conditioned premises to exclude dust. The sealing and impregnation also is a highly skilled operation. In other countries telephone manufacturing and cable industry generally do this type of work. No recommendations in regard to their manufacture need be made at this stage. As the manufacture of goods such as telephones and cables etc. develop in the country the manufacture of static condensers also will be automatically taken up by a suitable agency.

91. *Electric Cables and Wires.*—(i) Insulated wires and cables are among the most important engineering stores required both by the industrial as well as the civilian consumers of electric power. Insulated winding wires are used by the electrical engineering industry in the manufacture of fans, motors, transformers and other electrical equipment. Bare copper conductors and all the larger sizes of rubber insulated cables, together with paper insulated cables, are, however, almost exclusively used for industrial and power installations only.

(ii) The principal raw material used by the industry is "hot rolled electrolytic black copper rods" and before the war, they had to be imported. They are now produced indigenously in Calcutta from electrolytic wire bars imported from S. Africa, Rhodesia, U.K., U.S.A., and Canada. Of the other raw materials, tin and lead have to be imported whereas cotton yarn, fabrics, rubber and chemicals are available from indigenous sources. Highly purified lead may be available to the industry locally in the near future.

(iii) The first factory for production of cables and wires was established in 1921 in Tatanagar. Their pre-war range of manufacture was bare copper wires, cotton covered winding wires and rubber insulated cables and by 1939 they were catering for a considerable portion of India's pre-war demands of these stores.

(iv) During the war, due to increased demands from the Defence Services and Posts and Telegraph Department and also due to difficulties in obtaining requirements by import from U.K., it was found necessary to expand the capacity of the indigenous industry.

(v) A factory was established in the Central Provinces primarily for augmenting the production of bare copper conductors for meeting the very large demand arising out of the tele-communications development scheme of the Government of India. This factory has now been transferred to Calcutta where they have installed a plant for the manufacture of insulated wires and cables also. They have ordered necessary plant for the manufacture of enamelled wires and are expected to go into production within the next few months.

(vi) The Government also set up a factory at Tatanagar for meeting the enormous Defence Services demand for "D" class cable which is a special type of army signalling cable. This factory was run by the existing cable factory in Tatanagar and it is understood that the latter factory will take over in due course the Government factory with a view to convert it for production of stores required for civilian consumption.

(vii) The present production capacity in respect of various types of cables and wires is indicated below:

Description	Pre-war capacity	Actual pre-war production	Present capacity
	(per annum)	(per annum)	(per annum)
1. Bare copper conductors	7,200 tons.	3,600 tons.	24,000 tons.
2. Rubber insulated electric cables.	20,000,000 yds.	8,000,000 yds.	40,000,000 yds.
3. Cotton covered winding wires.	200 tons.	120 tons.	300 tons.

(viii) The average annual imports, during the five years preceding the war were of the value of approximately Rs. 13 lakhs of bare copper wire and Rs. 79 lakhs of all types of cables. Our conclusions are given below against individual items.

92. Copper conductors.—(i) The entire range of bare copper wire manufacture of the total installed capacity of 24,000 tons per year of the two firms is sufficient to meet the country's anticipated demand of approximately 14,000 tons per annum.

(ii) Till about two years back, India had been importing black copper rods for drawing them into copper wire. But with the establishment of the factory in the Central Provinces, it was decided to import only electrolytic copper wire bars to be rolled into copper rods and further drawn into copper wire by that factory as well as the one in Tatanagar.

(iii) The information furnished to the Panel in regard to the costs of electrolytic copper wire bars cannot be properly verified by the Panel and is given below.

One source states:—

“Before the war, German and Japanese cables and wires used to be sold in India at such low prices even after paying a larger rate of import duty, that no other make could compete with them in prices. The manufacture of these goods was said to be subsidised by the respective Governments.

There was no evidence of any form of subsidies in the U. K. before the war and even during it. Experience of the last one year, however, shows that electrolytic copper is being subsidised by the U.K. Ministry for consumption in the home market; otherwise a home market price of £62 per ton as against an export price of approximately £78 per ton for the electrolytic copper wire bars is unaccountable. This large disparity in price of the most important raw material straightaway places the U.K. manufacturer over the manufacturer in India, and affords him scope to import his products in India and sell them at favourable rates

even after paying duty at 10 per cent. in the case of copper wires, and $7\frac{1}{2}$ per cent. in the case of V.I.R. cables, as these rates cannot take care of such contingencies."

From another source the information is as follows:—

"Basic prices ruling in the U.K. during 1946:

Prior to 8th April 1946	£ 62 per ton.
April 8th and prior to 1st July 1946	£ 72 per ton.
1st July and prior to November 13, 1946	£ 84 per ton.
13th November and after	£ 98 per ton.

These figures are, we understand, taken from Messrs. Bagott and Thomson's Commercial Daily Reports.

To the best of our knowledge there is only one price quoted by U.K. manufacturers for electrolytic wire bars, that price also holding good for export trade. Owing to the scarcity of electrolytic copper during the last 18 months there has been an embargo on English manufacturers exporting E.W. bars since the stocks available were barely sufficient to meet home consumption."

(iv) The Panel asked the representative of the first source to give evidence in regard to costs to the Indian industry of electrolytic copper wire bars and were advised that since the outbreak of the war the Non-ferrous Metals Control, U.K. Ministry of Supply, took over control of all electrolytic copper and made it available to essential consumers. Under this scheme one consumer in India obtained initial supplies of wire bars at the rate of £62 per ton C. & F. Calcutta. Later on this price was increased to £62-10-0 per ton and again to £71 per ton though the price in U.K. remained at £62 per ton. It was stated in this connection that the price of £62 per ton for the U.K. market was only applicable to U.K. consumption and that no export of bare copper wires was allowed. Government agreed to release necessary dollars for purchase of copper wire bars in America and the then American price was £72 per ton. It was further stated that the American price as quoted in the Metal Market Bulletin from London was raised to £78 per ton whereas the prices for U.K. requirements remained at £62 per ton, which indicated that the U.K. Ministry was giving a preferential advantage to the industry engaged in electrolytic copper in the U.K.

(v) This question requires a detailed investigation through Government channels and after the costs to the electrical industry of this essential raw material is properly established, Government should take steps to subsidise the industry to ensure the required output.

93. Aluminium Conductors.—(i) At present steel reinforced aluminium conductors are not being manufactured in the country. During the five years preceding the last war the annual import of these conductors was very limited. Their use for power transmission lines is increasing rapidly. They are at present about 30 per cent cheaper in cost than copper conductors. With the development of hydro-electric projects, orders for approximately 2,000 tons have already been placed for these conductors and the demand will increase steadily with further development of generating capacity. It is expected that the total demand for the years 1946 to 1951 will be of the order of 15,000 tons. This figure has been based on information received from Governments of Bombay, Madras, C. P. and Berar and Orissa and from Hyderabad, Mysore and Travancore States. The requirements of remaining Provinces and States have been estimated in the light of information received regarding the developments in such Provinces and States. An estimated amount to cover the needs of certain major projects has also been added.

(ii) A factory for the manufacture of these conductors is being set up in the Travancore State with the support of the Government of Travancore. This plant is expected to go into production towards the end of 1947 and will have a capacity for producing 2,000 tons of conductors per annum. As the anticipated demand will undoubtedly be more than the quantity likely to be produced by the Travancore plant, the establishment of other plants is recommended. Suitable location will be in the Central and North-Eastern parts of the country. Owing to the extensive availability of bauxite in the country and the possibility of extraction of aluminium at very low costs compared to foreign countries, it is very necessary that the Council of Scientific and Industrial Research make a special investigation for the substitution of aluminium in place of electrolytic copper, the shortage of which is a severe handicap to the industry. It is understood that more extensive use of aluminium conductors in foreign countries is probably not made on consideration of costs only. If satisfactory results are achieved as a result of the investigation suggested, it will enable the country to be self-sufficient not only in respect of the requirements of cables and wires but the country's production of copper could probably be diverted to better purposes.

94. Rubber Insulated Cables.—(i) As regards rubber insulated electric cables, at present the only factory in production is at Tatanagar and its annual capacity is 25,000,000 yds. but in the very near future the factory at Calcutta is expected to go into production with an output of 15,000,000 yds. per annum. India's estimated demand of these cables during the next five years is likely to be 250,000,000 yds. The country should aim at an annual production of 125,000,000 yds. during the next five years and 250,000,000 yds. during the subsequent five years. This would necessitate the establishment of further factories in other towns like Bombay, Lahore, Karachi, Cawnpore, Bangalore and Hyderabad (Dn.), where electrical energy required for these factories would be available.

(ii) For the increased production suggested during the first five years' programme, a capital of Rs. 180 lakhs would be required. Capital goods of approximately Rs. 20 lakhs would require to be imported and approximately Rs. 40 lakhs to be obtained from the Indian market.

95. Insulated Winding Wires.—(i) Cotton covered wires are at present produced by the Tatanagar factory but very soon the Calcutta factory will also go into production. The latter factory has imported a plant for producing enamelled wires also. The available capacity for the production of insulated winding wires is approximately 300 tons per annum whereas the annual demand during the next five years is likely to be 3,500 tons. Manufacturers of rubber insulated cables should also manufacture these wires at the rate of 1,800 tons per annum during the first five years and 3,500 tons during the second stage of five years.

(ii) Owing to the difficulty in obtaining silk yarn, silk covered wires are not being manufactured at present but attempts are being made to import right type of silk yarn. It is unfortunate that despite the existence of several mills in the country, the right type of silk yarn required for silk covered wire industry is not being produced. With proper research and assistance of the proposed National Physical Laboratory, the production of silk yarn of the correct quality, should be established.

96. Other types of cables.—The manufacture of other types of cables such as paper insulated, lead covered, armoured cables, cambric covered cables, etc., should be left to the normal development expected in the cable industry.

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97. Switchgear.—(i) The range of switchgear manufacture in India covers (1) knife switches and fuses including ~~for all domestic and industrial switch-~~

proposals in regard to National ~~Physical~~ Laboratory of the Industry in Chapter VI *infra*

gear of 15 to 200 amps. capacity, (2) manually operated disconnecting switches, suitable for a voltage upto 33 K.V., (3) simple type switchboards, and (4) fabricated switchboards. The production has so far been very limited. Almost all the components required for the switchgear are being produced in the country. Electrical instruments required for switchboards have to be imported.

(ii) During the five years preceding the last war, the cost of the annual average import of all types of switchgear was approximately Rs. 58 lakhs. The country's present day annual requirements of knife switches and fuses is approximately 400,000 Nos. and that of circuit breakers roughly 25,000 Nos. Figures in respect of other items are not available. Owing to rapid industrialisation during the post-war period the demand for all types of switchgear will increase considerably.

(iii) Local manufacture of switchgear of the value of Rs. 2 crores per annum of the four specified types is recommended during the first five years. During this stage the manufacture of circuit breakers is not recommended, as high technique will be required for their manufacture. During the second stage of five years it is recommended that all types of switchgear, including circuit breakers having a rupturing capacity of 250 K.V.A. of the value of Rs. 4 crores should be manufactured per annum.

(iv) The capital required for the manufacture of switchgear for the first five years' programme would be approximately Rs. 4 crores, out of which Rs. 125 lakhs would be required for capital goods consisting of Rs. 60 lakhs worth to be obtained from the Indian sources and the remaining to be imported.

(v) Switchgear manufacturing factories are located in Calcutta, Bombay, Bangalore and to a small extent in Lahore. With a view to meet the future increased demands of the country, further factories should be installed at the above specified place and in other towns such as Tatanagar, Madras, Peshawar, Karachi and Dibrugarh.

98. Transmission and Distribution Poles and Pole Fittings.—(i) Transmission and distribution poles and pole fittings are manufactured extensively in the country. During the last war, Government's demand for these increased considerably due to the expansion of tele-communications scheme. All these requirements were met from the country's resources. The small scale industry of Calcutta was largely responsible for complying with the large requirements of pole fittings. During the post-war period the demand for this equipment will increase rapidly with the development of various electrification projects. The other main demand will be from Posts and Telegraphs Department but their requirements are met by Departmental workshops.

(ii) Transmission and distribution poles mainly consist of solid-drawn steel, rivetted steel, second hand rail, wooden and ferro-concrete poles and as the manufacture of these poles and pole fittings would be undertaken by structural and hardware industry or by the cement and concrete industry, we have referred the question of development of the transmission and distribution poles and pole fittings industry to the appropriate Panels. The respective Panels will give due consideration to the location of these industries to suit the needs of the electrical industry. In our opinion their manufacture should be extensive rather than concentrated in a few centres.

99. Insulators.—(i) Insulator manufacturing industry has been well established in India and the factories are located in Calcutta, Bangalore, Gwalior, Delhi and Morvi.

(ii) The existing manufacturing capacity of nearly 1,000 tons of insulators per annum is largely restricted to all types of low tension insulators required by the Posts and Telegraphs Department, electrical utility undertakings and radio industry. The quality and price of these insulators compare very favourably

with those of imported insulators. Existing manufacturers are increasing their output so as to cope with the increased prospective demand.

(iii) Since the commencement of the Second World War, some factories attempted manufacture of high tension insulators. For want of suitable equipment for testing and refining of clay their products were not to required standards. Steps to import high tension testing equipment have already been taken by several factories. As the reliability of electric supply greatly depends upon the quality of insulators used in transmission and distribution lines, every assistance for improving equipment for testing and refining clay should be given to the industry.

(iv) During the first stage of five years the industry should expand its output to approximately 5,000 tons per annum of all types of low tension insulators. Local manufacture should be encouraged of high tension insulators upto 11 K.V. in the first, 66 K.V. in the second and all voltages in the third stage of development. A forecast of consumption of these insulators required very detailed investigation. The Departments concerned should prepare these estimates and advise the manufacturers so that the industry may prepare their future plan.

100. Electrical Measuring Instruments.—(i) Ammeters, voltmeters, wattmeters, house-service meters, power-factor meters, meggers, galvanometers, potentiometers, etc., come under the purview of electrical measuring instruments manufacturing industry. Public utility undertakings, Telegraph, Telephone, Survey, Meteorological Departments, Schools, Colleges, etc., require these in some type or other.

(ii) At present, manufacture of these instruments is in a very elementary stage in India. During the five years preceding the last war, the average annual import of all types of instruments was about 100,000 Nos. costing approximately Rs. 10 lakhs. The normal pre-war requirements of the country may be estimated at 100,000 meters of all types. With rapid development of electrification, the post-war annual requirements of meters would be approximately 300,000 nos. and these would mainly consist of house-service meters. A production of 100,000 house-service meters per annum during the next five years and 300,000 nos. during the second five years is recommended. The manufacturers of house-service meters should undertake manufacture of other types of meters. Though the demand for other types is comparatively small their local manufacture is of extreme importance in the future development scheme.

(iii) Capital required for attaining the target for the first stage would be about Rs. 25 lakhs and capital goods of approximately Rs. 15 lakhs will need to be imported.

(iv) The import of raw materials and components such as nichrome wire and magnets required by the industry should be permitted free of duty.

(v) At present small factories are installed in Poona and Bombay. Further expansion of these factories and establishment of more factories in towns like Lahore, Hyderabad (Dn), Cawnpore and Nagpur is recommended.

101. Signalling and Interlocking Instruments.—Signalling and interlocking instruments are mostly used by Railways and so far the demands have been met by imports. The figures in respect of these imports are unfortunately not available. Several factories in Calcutta are manufacturing with success components for this equipment as a side line. With necessary assistance from the Railway Department in securing designs, samples, etc., these manufacturers should be able to meet to a considerable extent the country's requirements. The existing electrical equipment manufacturers should be encouraged to develop its production as a side line. No difficulty should be experienced in manufacturing the equipment as specialised technique would not be needed. Additional capital and the cost of additional capital goods would not be appreciable.

* See Chapter VI—Nationalisation of Electrical Industries *infra*.

102. Factory Electrical Equipment.—(i) The equipment mainly consists of electric sirens and hooters, soldering irons, electric hoists and cranes, lifting magnets, magnetic separators and magnetic chucks.

(ii) Electric sirens and hooters are produced in Calcutta and Lahore by manufacturers of electric motors and during the war the industry developed sufficient capacity to meet the very large demands of the Defence Services. With the cessation of war these demands have been considerably reduced. The industry does not require any further development and should be assisted by Government in the export of its products, which have been found to reach the required standards.

(iii) The requirements of soldering iron are comparatively very large. So far very little attempt has been made to produce them. Manufacturers of electric domestic equipment should take up their production. The manufacture does not involve special equipment or high technique.

(iv) Electric hoists and cranes are produced in Calcutta and Bombay to a very limited extent. Their production involves the assembly of electrical components like motors and switchgear with mechanical hoisting gear. The electrical and mechanical components for these are being manufactured by the respective industries. The development of motor, switchgear and mechanical industries should take care of the increased demand for electric hoists, cranes, etc.

(v) The manufacture of other items like lifting magnets, magnetic separators and magnetic chucks have not so far been undertaken. As the demand for these items will be limited, the establishment of separate factories is not called for. The transformer manufacturers should undertake the manufacture of these items. A large outlay on capital goods would not be necessary. Foreign technical assistance for designing and planning of production in the initial stages would be needed and Government should provide necessary facilities.

103. Miscellaneous Electrical Equipment such as Furnaces, Ovens and Hospital Equipment.—(i) This category covers a number of items some of which are highly specialised items of manufacture. Amongst the specialised items of manufacture may be taken high frequency melting furnaces, X-Ray equipment for medical purposes and testing of metals, artificial lungs, surgical equipment for hospitals and dentists such as electrical knives, etc. The minor items under this category are electrical ovens, sterilizers, incubators, hair curlers, clippers, etc.

(ii) The specialised items would require a very high standard of workmanship, technique and design and considerable research. No attempt has so far been made in India to manufacture any such highly specialised items. With the expansion of medical facilities and the industries of the country a considerable amount of this equipment would be required. It is not possible to forecast the requirements either by types or by numbers. The Electrical Machinery and Equipment Board, the formation of which is recommended in this report, should in co-ordination with Government arrange for higher technical education and research and for specialised training in regard to designing and manufacture of these items with a view to developing the manufacture at a later stage when the country would be in a position to assess its requirements on a sound basis.

(iii) Manufacture of the minor items such as ovens, sterilizing equipment, incubators, hair-curlers, etc., is not highly technical and has been attempted to a certain extent. As the demand increases, the existing industries manufacturing domestic electrical equipment should take care of it in their future expansion schemes.

104. Electric Welding Plants and Accessories.—(i) Electric welding plants are widely used by all factories and workshops. So far no production of welding plants has been undertaken in India. The requirements of the country are

being met from imports. Figures in respect of the quantities and values of these imports are not readily available. However, with the rapid industrialisation of the country, the demand for the equipment will be considerably enhanced.

(ii) Since the manufacture of welding plants involves manufacture of motors, generators and transformers, the motor and generator industry and the transformer industry should develop the production of these plants. The production will involve special technique, but no additional capital nor capital goods should be needed. Government should assist the local industry in obtaining foreign designs and technical assistance.

(iii) Electrodes are at present being manufactured to a limited extent in Bombay, Calcutta and Lahore and in course of time this industry will be in a position to meet the requirements of India and even export to the adjacent countries.

(iv) Mild steel wire required for the manufacture of electrodes is produced in the country. Special types of steel wires for certain types of electrodes have to be imported and customs duty on these should be abolished. Indian producers of steel are in a position to cater for these requirements, and the steel industry should be asked to arrange for it within a specified period, say five years, so as to eliminate imports, when imposition of protective duty may also be considered.

105. Refrigerator and Air-conditioner Equipment.—(i) The average annual import of the equipment during the five years preceding the war was approximately of the value of Rs. 15 lakhs.

(ii) With the increasing use of refrigeration plant in the development of industries as fisheries and photography and the requirements of hospitals, hotels and similar institutions, as well as of industries, the demand for refrigerators and air-conditioners will be very large.

(iii) During war, a firm in Satara produced a few air-conditioners and at present several industrialists are negotiating with foreign firms for establishing the industry in India. The development of this industry in the country will depend mainly on the initiative shown by Indian industrialists and the co-operation they are able to obtain from foreign manufacturers holding patents, without the use of which it will be difficult to operate a manufacturing unit in the country with any measure of early success. Government should take special interest in the development of this branch of the industry and give encouragement to its establishment in the larger interests of the country.

(iv) During the next five years, factories should be established in towns like Bombay, Calcutta, Mysore, Bangalore and Hyderabad (Deccan) for assembling the equipment from components imported from abroad with the exception of cabinets and motors. During the succeeding five years, the industry should be further developed with a view to manufacture all components and to meet India's entire requirements.

(v) Local manufacture of compressors would need to be developed to a very efficient level for purposes of developing the manufacture of refrigerators, air-conditioners, etc. Compressors are required for a variety of purposes such as road making equipment, garage equipment, operation of tools and equipment by compressed air, etc. The raw materials for manufacture of compressors are readily available and the required equipment also exists. The main difficulty is accurate workmanship and a high degree of finish. The panel for Heavy Machinery Industries would perhaps pay special attention to the establishment of its manufacture, as manufacturers of refrigerators, air conditioners, etc., always obtain their requirements of compressors from specialists in the line.

(vi) Apart from compressors, the raw materials required are seamless non-ferrous alloy tubes, electrical wiring, ferrous and non-ferrous sheet metal and refrigerating gases. Except for alloy tubes and gas, which are imported by

foreign firms, the other items would be available from local sources. Certain components such as thermostats and pressure equalising valves that are covered by patents, will need to be imported in the initial stages. Duty free import of all such components by local manufacturers should be allowed for assisting development of the industry. Local manufacture of components such as motors, cabinets, switches and door fittings (which are specialised types) exists or can be readily developed. The question of reimposing customs duty on the items of import should be examined during the second stage of development.

(vii) Estimates for capital outlay cannot be furnished at the present stage but, in accordance with the general trend in America where manufacture of this equipment has been highly specialised, Indian automobile manufacturers should be encouraged to develop this industry.

106. Light Electrical Industries.—It is gratifying to note that three important light electrical industries, viz., fan, lamps and storage and dry batteries industries are already fairly established and developed. Steps have been suggested to further develop these industries with view to meet not only the anticipated increased demands of India but also to cater for the markets of adjacent countries. Sufficient consideration, however, does not appear to have been given to the manufacture of radios, electric fittings and electric domestic equipment, with the result that most of the country's requirements are met by imports. The demand for these items is rapidly growing and the country should develop these industries.

107. Insulating materials industry, covering important materials required in the manufacture of all electrical products, has been sadly neglected. We have recommended in Chapter VI that Government should take initiative in the early establishment of this industry. The development of dairy electrical, sound recording and automobile electrical equipment industries, where the requirements are not likely to be large, may be left to the initiative of the commercial entrepreneurs.

108. Radio Receiving and Transmitting Sets.—(i) Several factors have impeded the growth of the listening public of India as is amply borne out by the following comparative figures of licences issued in various countries.

Country	Population	No. of licences.
India	400,000,000	200,000
U. S. S. R.	170,000,000	10,351,361
Britain	44,000,000	9,884,000
Italy	43,000,000	1,020,845
France	42,000,000	5 248,445
Belgium	8,300,000	902,445
Holland	8,100,000	410,197
Hungary	7,000,000	903,855
Switzerland	4,600,000	850,000
Sweden	6,600,000	1,900,012
Australia	7,000,000	1,500,000

(ii) The number of broadcasting stations in the country is so small that unless high powered expensive sets are installed it would not be possible to satisfy the requirements of the people, specially dwellers of villages. The following figures reveal the position of broadcasting service when compared with that in other countries.

Country	Population	No. of broadcasting stations
India	400,000,000	15 (including States)
Australia	7,000,000	139
U. S. A.	135,000,000	900

(iii) Since broadcasting is the easiest and cheapest mode of imparting general knowledge to the public, Government would do well to develop broadcasting in India. That will promote the growth of the listening public and the indigenous radio industry.

(iv) Another important factor hampering the installation of receiving sets is the prohibitive price at which both high and low powered sets are sold in the market. Government have imposed a heavy preferential duty of 48 per cent on sets imported from U. K. and 60 per cent on products of other countries. Middlemen add a large profit-margin making the cost to average purchaser prohibitive.

(v) The pre-war demand of receiving sets was approximately 30,000 Nos. per annum consisting mainly of all-wave sets of medium power. The demand for transmitting sets was confined to that from the Government and it was very limited.

(vi) The average annual import during the five years preceding the last war, of both transmitting and receiving sets, was of the value of Rs. 32 lakhs. Separate figures in respect of these two items are not available.

(vii) During the pre-war period no attempts were made to produce either receiving sets or transmitting sets in the country. At present, with the exception of one firm which has commenced the manufacture of complete radio sets excluding valves, some firms are attempting to assemble receiving sets from parts mostly imported from abroad.

(viii) The demand for receiving sets increased considerably during the war period and is constantly increasing. With the growth of electrification and installation of more broadcasting stations the demand will be very large. It is estimated that during the next five years the average annual demand would be approximately 400,000 cheap popular and 100,000 high powered sets.

(ix) The manufacture of radio sets, including all the components with the exception of valves, should be immediately taken in hand with a view to produce 400,000 cheap popular and 100,000 high powered sets per annum during the next five years and this output to be further augmented with the expansion of broadcasting service during the succeeding stages.

(x) Capital required for the establishment of the industry would not exceed Rs. 2 crores. The value of capital goods required would be small and would consist mainly of testing equipment, which would have to be imported.

(xi) As regards raw materials, with the exception of valves, enamelled, silk covered and nichrome wires and insulating materials, almost all other raw materials are available in the country. However, in the course of next five years local manufacture of enamelled and silk covered wires will be developed.

(xii) With a view to assist the industry, radio valves, which are not likely to be manufactured in the country in the next five years, should be allowed to be imported free of duty and the question of reimposing the duty should be examined after five years.

(xiii) For achieving the target aimed at during the next five years, four to five factories will be required. One factory is already set up in Bombay and the establishment of further factories in Calcutta, Karachi and Bangalore should be contemplated.

(xiv) Transmitting sets are closely allied to receiving sets. With the impetus given to the manufacture of receiving sets together with the further expansion of broadcasting service, the manufacturers of receiving sets should produce transmitting sets.

109. Electric Lamps.—(i) Electric lamps include general service type, telephone switchboard, automobile and train lighting lamps, torch bulbs and neon and fluorescent lights.

(ii) The pre-war demand of all the specified types was approximately 10 million per annum. The average annual import during the five years preceding the last war was of the value of approximately Rs. 28 lakhs.

(iii) The electric lamp industry was set up in India before the commencement of the second world war and its further expansion took place during the war period. The Indian production in 1938 of the general service type of electric lamps was of the order of three millions and subsequently in 1945 it increased to six millions per annum. The potential capacity of the already established manufacturers at Calcutta, Bombay, Karachi, Mysore, Patna and Shikohabad is about fifteen million lamps against India's annual requirements of nearly eighteen millions. Additional machinery has been indented for by the existing manufacturers to achieve a production of 31 million lamps per annum.

(iv) At present general service type up to 500 watts, telephone switchboard, automobile and train lighting lamps are being produced and steps have been taken to produce in the near future lamps of even higher wattage and torch bulbs. Necessary technical data are being collected for the production of neon and fluorescent lamps and in the first stage of five years India should be practically self-sufficient in respect of her requirements of electric lamps of all types.

(v) The industry should aim at producing 31 million lamps per annum during the next five years. As the existing manufacturers have already made provision for the production of 31 million lamps, the question of establishing further factories or expanding the existing factories in the near future does not arise.

(vi) Many raw materials such as gas and molybdenum wire, and component parts as caps, etc., are required for the manufacture of electric lamps and almost all of them, with the exception of some glass shells, are imported. The existing manufacturers have taken steps to import suitable machinery for manufacturing these components and during the course of the next five years, the necessity of importing these components also is likely to disappear.

(vii) The Government has recently removed the duty on imports of all raw materials and components required in the manufacture of lamps and the Panel recommends continuance of this policy.

(viii) When compared with lamp manufacturing industries established in foreign countries, Indian industry is still in its infancy and consequently the existing duty on the imports of all general service type lamps should be adequately increased to protect the growing industry at least for next few years till production is increased and cost of manufacture has been reduced.

(ix) As the anticipated production of 31 million lamps will be much more than the country's requirement of 18 million lamps, the surplus lamps should be available for export to the surrounding countries.

(x) Manufacture of valves for radio receiving and transmitting sets has not been attempted in the country so far. Identical to it is the question of manufacture of X-ray tubes and fittings. Manufacture of these items can be undertaken by the lamp industry, as is being done in other countries, but a high degree of technique and research is needed to produce these items in satisfactory quality. Manufacturers of radio receiving and transmitting sets and X-ray apparatus in foreign countries obtain their requirements from specialists, who, through research and experiment over a number of years, have evolved designs of valves and X-ray tubes of high quality. It is emphasized that manufacture should not be attempted unless the production of high quality articles is ensured and it will therefore be necessary for Government to provide facilities for training and even considerable subsidy in the initial stages of the industry.

110. Electric Fittings.—(i) Electric fittings play a very important part in the use of electric energy. The manufacture of these in India has been sadly neglected. Only to a very limited extent bakelite switches, ceiling roses, cut-outs and similar accessories are being manufactured by the plastic industry at Calcutta, Bombay, Lahore and Mysore. So far very little has been done to produce polished brass lamp holders, brass covered switches, brackets and such fittings.

(ii) The average annual import of fittings during the five years preceding the last war was of the value of approximately Rs. 7 lakhs.

(iii) With the development of electrification projects the demand for electric fittings will be considerable and constantly increasing. The industry should aim at manufacturing Rs. 40 lakhs worth of fittings per annum during the next five years.

(iv) The nature and volume of these goods do not justify the installation of special plants for manufacturing them but the existing and rapidly developing bakelite industry and small scale factories could with advantage devote their energy towards the manufacture of these articles. The industry should have no difficulty in manufacturing these articles as high technique is not involved. Capital and capital goods required by the industry would be very limited.

(v) All raw materials with the exception of bakelite powder and non-ferrous bars are available in the country. Bakelite powder is being manufactured in very limited quantities in Bombay and steps should be taken by the chemical industry to establish more factories to increase its production and improve its quality. Rolled non-ferrous bars are also produced in India, but they are not rolled to sufficiently close tolerances with the result that thread cutting is made most difficult. The non-ferrous industry should develop this product with a view to satisfy the needs of electrical industries. Till such time as these are produced in the country of correct quality their duty free import is recommended.

111. Storage Batteries.—(i) The importance of lead acid storage battery manufacture in a nation building programme will be evident from the fact that they have a very extensive usage. Modern mechanised transport systems—rail, road, sea or air—rely to a very great extent for starting, lighting and other operations, on such batteries. Every automobile on the road has at least one battery performing the essential functions of starting, lighting and ignition. Train lighting batteries are used for lighting purposes and operation of fans. The modern applications for batteries in Railways include air-conditioning, railway signalling for track and signal circuit and switching locomotives. The marine applications for batteries are multi-farious. They assure continuity of power for lighting and wireless and carry peak loads of pumps, hoists and compressors. On naval vessels storage batteries provide for gun firing and for the propulsion of sub-marines. Storage batteries furnish current for various purposes in telephone services such as transmitting, signalling and switching, and for repeaters and tele-printers. Air-craft batteries supply current for engine cranking, radio, ignition, navigation instruments, landing gear, cabin lights

and power apparatus. In places, not served by central-station power, farm lighting batteries are generally in use. High potential batteries are in wide use in broadcasting stations as well as in radio receiving sets.

(ii) The lead acid battery manufacture was started in India in 1932. The industry's pre-war capacity was about 35,000 sets per annum but this mostly consisted of plate manufacturing and not complete batteries. With the advent of war and consequent short supply of imported batteries the indigenous industry was called upon to meet the large demands of the Defence Services. With the assistance of the factories already established the industry was able to cope with these requirements satisfactorily. These factories are located in Calcutta, Bombay and Bangalore. Recently one more large plant has been installed in Calcutta.

(iii) The combined import of storage and dry batteries during the five years preceding the last war was of the value of approximately Rs. 23 lakhs per annum. Separate figures for imports are not available.

(iv) The demand for storage batteries will considerably increase with the development of large rural electrification schemes, the establishment of motor-car industry, the post-war development of the Indian Posts & Telegraphs Department and general industrial expansion. The requirements of lead acid batteries are estimated to be approximately 150,000 Nos. per annum. The present planned manufacturing capacity is more than sufficient to meet the country's entire requirements of all types of batteries. The batteries so far manufactured are, however, mainly of the type used in transport vehicles but with necessary assistance from Government Departments like Posts & Telegraphs Department, Railways and Defence Services in the form of loan of designs and, where possible, samples, the industry should be in a position to meet other requirements as well.

(v) The industry should aim at producing 200,000 lead acid batteries per annum during the next five years. The manufacture of nickel-iron and nickel-cadmium batteries has so far not been undertaken and the existing manufacturers should be able to manufacture these batteries also. Government should assist in purchase by local entrepreneurs of proprietary rights for these types of batteries.

(vi) With the exception of one firm which has a self-sufficient plant for the manufacture and assembly of all the components, the other firms manufacture plates and assemble batteries from components mostly imported from abroad. Most of the firms have, however, already arranged for the import of capital plant and machinery for manufacturing all the components and within the course of the next two years or so the import of these components would also cease.

Lead and antimony are imported.

(vii) At present the manufacturers are handicapped by the disparity in the price of raw materials used in the manufacture of batteries prevailing in U. K. and U. S. A. on one hand and that at which they can be obtained in India. The relative costs are given below for comparison.

	Price in India	Price in U. S. A.	Price in U. K.
	Rs. a. p.	Rs. a. p.	Rs. a. p.
Lead . . . per ton	668 0 0	480 7 8	293 0 0
Antimony . . . do.	5,500 0 0	1,108 1 3	1,502 10 0
Litharge . . . do.	960 0 0	628 5 2	Not known
Separators . per 100 pieces	9 0 0	2 0 0	2 0 0
Containers . per piece	9 8 0	2 11 4	4 14 6
Sulphuric Acid . per ton	290 0 0	Not known	Not known

(viii) Based on the above prices, the material cost of one 6 volt 13 plate-battery works out in the respective countries as follows:—

India	U. S. A.	U. K.
Rs. a. p.	Rs. a. p.	Rs. a. p.
22 0 0	11 7 0	11 13 0

Adding duty at 37½ per cent to U. S. A. and U. K. battery costs, the respective figures will be:

India	U. S. A.	U. K.
Rs. a. p.	Rs. a. p.	Rs. a. p.
22 0 0	15 12 0	16 3 0

The above stated prices are as ruling about a year back and have since varied. However, these are good enough for the purpose of our investigation.

(ix) Owing to this handicap, the indigenous manufacturer finds it difficult to manufacture batteries at a price which will compete with the imported batteries. Government should investigate the reasons causing the disparity and assist the industry.

(x) With a view to protect the industry against competition from well established foreign manufacturers, application of protective duty on imported finished product is recommended, at least for next few years till production is increased and cost of manufacture has been reduced.

(xi) As the capacity of the existing manufacturers will be much in excess of the country's requirements, facility for export of batteries should be afforded by Trade agreements with neighbouring countries.

112. Dry Batteries.—(i) Dry batteries are largely used in electric torches, medical apparatus, radios and such establishments as Posts & Telegraphs Department, and the Defence Services.

(ii) The first factory for the manufacture of dry batteries was established in Bombay in 1934. Subsequently another large factory came into operation in Calcutta. Besides these two factories, there are a few small plants in Lahore and Agra, which are at present in an experimental stage.

(iii) The pre-war capacity of the industry was roughly 15 million cells per annum.

(iv) During the war period, the demand for batteries from the Defence Services increased considerably and were entirely complied with by the indigenous industry.

(v) With the cessation of war, demand from Defence Services will be much less but owing to general industrial development, the requirements on the whole will be considerable and are likely to be roughly 500 million cells per annum. Sufficient capacity is, however, being established by the expansion of the existing factories to produce approximately 750 million cells per annum.

(vi) The target to be aimed at by the industry during the first stage of five years should be 750 million cells per annum.

(vii) Several raw materials such as chemicals and waxed paper and components like brass caps are being imported at present. The existing factories have made arrangements to import necessary machinery for manufacturing components, and in due course there should be no import of these components.

(viii) As regards disparity in cost of raw materials, tariff and export facilities, the dry battery industry is on the same footing as the lead battery industry, and the assistance recommended in the latter case should also be rendered to this industry.

113. Electric Fans.—(i) The manufacture of electric domestic fans in India was set up long before the last war and it is estimated that the pre-war capacity of the factories established in Calcutta, Bombay, Lahore and Amritsar was in the neighbourhood of 40,000 fans per annum.

(ii) During the war, with a view to meet the very large demand of Defence Services, the industry was rapidly developed. The present capacity is approximately 150,000 fans per annum which is a conservative estimate and does not take into account the production of a large number of small manufacturers.

(iii) The pre-war demand for electric domestic fans is estimated to have been between 60,000 to 80,000 fans per annum. The average annual import of fans during the five years preceding the last war was of the value of approximately Rs. 27 lakhs.

(iv) With the rapid development of electrification projects, the post-war demand for fans will be considerable and it is likely to be in the neighbourhood of 150,000 fans per annum.

(v) The industry should aim at manufacturing 200,000 fans per annum for the next five years. Additional capital goods required for the expansion of the industry has already been ordered by the existing manufacturers.

(vi) The important imported raw materials and components are ball bearings, electrical steel sheets, insulated copper wires and insulating materials such as leatheroid, etc. Pig iron, R.S. flats, sheets and non-ferrous metals such as copper sheets and brass rods are available from indigenous sources. Since the manufacture of electrical steel sheets and insulated copper wires has already begun in the country, the import of these raw materials during the course of the next few years would be reduced.

(vii) As a very large stock of fans are stated to be awaiting disposal by the Government and as full capacity for the manufacturing requirements of the country already exists, although the free and regular supply of raw materials is not available, it is recommended that the import of the above specified types of fans may be regulated.

(viii) With the further expansion of the industry, a large number of fans would be left over as surplus and facilities for their export to the neighbouring countries should be afforded.

114. Electric Domestic Equipment.—(i) Electric domestic equipment includes such items as electric kettles, heaters, electric irons, ovens, etc.

(ii) The pre-war annual requirement for the equipment was small and was mostly met by imports. Owing to the negligible demand of the equipment, very little effort was made to produce it in the country. Pre-war import figures are not available.

(iii) At present a few factories in Bombay, Lahore and Calcutta are manufacturing the equipment but to a very limited extent.

(iv) With the expansion of electric supply and the availability of cheap electrical energy, the demand for these appliances would be considerable.

(v) The country should establish the industry with a view to produce Rs. 30 lakhs worth of equipment per annum during the next five years. The industry

should also undertake the manufacture of such fittings as incubators, hot air ovens, cream separators, sterilizers and other electro-medical apparatus. It should also develop the manufacture of soldering irons. Their requirements would be considerable as they would be needed by all large and small scale factories.

(vi) Capital and capital goods required for developing the industry would be very limited.

(vii) Important raw materials like copper and brass sheets, M.S. sheets, plates and rods and components such as porcelain parts and rubber insulated wires are available in the country. Nichrome wire has to be imported and should be allowed entry free of duty. The manufacture of this wire in the country should be encouraged.

115. Automobile Electrical Equipment.—(i) No attempts have so far been made to manufacture this equipment in the country as the manufacture of automobiles had not been undertaken. All the imported automobiles have the necessary equipment already fitted on them and any further demand for it has been in the form of replacement only. Information regarding the quantities of such equipment imported was called for from importing firms but the response has been most unsatisfactory.

(ii) Import of vehicles during six years preceding the second World War averaged annually 23,000 vehicles of different types and the replacements required would be between five to ten percent varying for different items. In some cases the percentage would even be lower than five. The annual demand of vehicles during post-war quinquennium period has been envisaged at 45,000 and even if these are manufactured in the country, the quantity of electrical equipment involved both for new vehicles as well as replacements would not be large enough to justify the establishment of a separate industry for the manufacture of these components. Should the manufacture of vehicles develop on sound lines, the industry would itself be in a position to introduce the manufacture of these auxiliary components on the lines they have developed in other countries. It may be noted that the manufacture of most of the components would require specialised high technique.

116. Telegraph and Telephone Equipment.—(i) The principal consumer of telegraph and telephone equipments in India is the Post & Telegraph Deptt. of the Government of India. The Railway Department and some of the Indian States consume relatively small quantities. Some mercantile firms also have private telephone exchanges installed in their offices for inter-communication between their different departments.

(ii) The Post & Telegraph Department has three workshops, one at Alipur (Calcutta), the other at Jubbulpore and the third one at Bombay. In these workshops all its requirements of telegraphs lines stores (except wire and insulators) are manufactured as also certain types of telephone subscribers instruments, Morse and Baudot telegraph equipment and so on. There are certain items of telephone exchange and telegraph office equipment, which the department is not in a position to manufacture and are, therefore, imported. The main items are (1) automatic exchange equipment, (2) high speed telegraph apparatus such as teleprinter, (3) telegraph and telephone carrier apparatus. The manufacture of the comparatively small requirements of these items not being an economical proposition the department has adopted the policy as regards indoor equipment to restrict the manufacture in its own workshops to its requirements of manual exchange equipment, subscribers telephone sets and the simpler types of telegraph apparatus as in the pre-war period. As regards line stores the increased capacity for their manufacture in the Post & Telegraph workshops during the war will meet the needs of post-war development.

(iii) The requirements of the above three items during the next ten years will be as follows:—

(a) **Automatic Exchange Equipment:**—The post-war plan of the Post and Telegraph Department provides for a number of new exchanges in small towns, the replacement of existing manual exchanges in medium sized towns and the expansion of existing automatic exchanges in larger towns. Provision has also been made for replacement of the Calcutta Manual Telephone System by automatic and for expanding the automatic systems in Madras, Bombay, Ahmedabad and Karachi. The approximate cost of automatic plant which will be required during the next ten years is Rs. 400 lakhs.

(b) **Teleprinters:**—Provision has been made in the post-war plan for 1500 new teleprinters. After making allowance for the teleprinters which will be taken over from the War Department it is estimated that 1200 teleprinters will have to be imported during the next ten years, the cost of which will be approximately Rs. 36 lakhs.

(c) **Carrier Apparatus:**—More plant has already been provided for the War Department during the last three years than will be required by the Post and Telegraph Department to meet its immediate post-war needs. The requirements of carrier apparatus during the next ten years will be, therefore, rather small.

(iv) The average value of telegraph and telephone equipments imported from the U. K. during the five years preceding the war was Rs. 17 lakhs per annum. With the post-war development envisaged above it is expected that the value of the average annual requirements will be of the order of Rs. 100 lakhs. The Post & Telegraph Department did not find it economical to manufacture this class of equipment in its workshops as its requirements were small but now that the requirements have increased considerably there is no reason why the manufacture of these equipments in India should not be a practical proposition. Automatic exchange plant forms a major portion of the equipments which will have to be imported. A factory has been started in India by the Telephone Manufacturers of India for the manufacture of small sized automatic exchanges. This firm should be able in two or three years' time to manufacture bigger sized automatic exchanges also. Carrier equipment can also be manufactured by the same firm. However, this firm is a combine of foreign interests in which indigenous capital or management have practically no place. In accordance with the recommendations made hereafter, prior to encouraging manufacture of the apparatus by the firm, Government should ensure that proper safeguards to protect national interests are introduced in the constitution of the firm. It is presumed that in accordance with the general policy in countries like England, France, etc., that unlike India are industrially advanced, firms of this type will adopt a more national structure voluntarily, failing which Government should exercise necessary pressure. In the event of such foreign concerns not co-operating with Government in the matter of changing their constitution to fall in line with the general policy, Government should take steps to establish manufacture independent of such concerns.

(v) There are some component parts of manual telephone exchanges which are now imported but which can and should be manufactured in India. Some firms in India have taken up the manufacture of some of the items, but the quality of these manufactured goods needs improvement. The Government of India should foster the industry by giving them technical and other assistance.

117. Dairy Electrical Equipment:—(i) Electrical equipment is used in the dairy industry for (a) production and handling of milk and milk products and (b) quality control work. In the case of former, the equipment consists mainly of refrigerating plants, refrigeration cabinets, pasteurizers, cream separators,

water and milk pumps, etc. For quality control work, electrical apparatus consisting of incubators, hot air ovens, heaters, etc., is mainly employed.

(ii) At present the requirement of dairy electrical equipment is very limited but with the inauguration of rural electrification scheme and with the growth of dairy farms, co-operative milk supply organizations, dairies, creameries, etc., the demand for the equipment will considerably increase. The manufacture of the above specified items will not constitute a separate industry by itself, but industries, such as refrigerator, air condition and electric domestic equipment should develop the manufacture of dairy equipment also. No difficulty should be experienced by the manufacturers as necessary capital goods and technique would be available for this.

118. Electrical Sound Recording Equipment:—(i) So far the demand for electrical sound recording equipment has been so little that no serious attempt has been made to build-up the industry. However, with the rapid growth of film industry, the demand for this equipment will increase.

(ii) Several attempts at copying foreign machines have been successfully made but it has not been found possible to produce these on a competitive basis. The equipment mainly consists of projective mechanism, sound equipment and stand and of these the manufacture of projective mechanism is a little intricate whereas that of the other two items is simple. As the demand for the complete equipment is not expected to be large, its manufacture should be developed as a side line by machine tool manufacturers. They should take the assistance of radio manufacturers for the manufacture of sound equipment. Additional machinery for the manufacture of the complete equipment would not be required.

119. Insulating materials:—The position in regard to their manufacture has been dealt with exhaustively under the Chapters on "Availability of Raw Materials" and "Nationalisation of Electrical Industries". Estimates of the country's requirements and capital goods needed for its development cannot be furnished. That large quantities will be required and necessary raw materials for its manufacture is available from local sources make it all the more necessary that Government take proper steps for developing this industry. If after investigation Government prefer commercial interests to handle this industry, it will be necessary that Government provide adequate protection and subsidy, as otherwise the electrical industry in India as a whole will be placed at a handicap as compared with foreign manufacturers.

120. Co-operation with foreign firms:—As will be seen from the preceding portion of the Report, there are certain industries that can develop better quality products or increase their volume of production without the assistance of foreign technicians or collaboration. However, there are many items in which the assistance of foreign interests would be essential for development of local manufacture. The nature of assistance that will be required has been mentioned wherever possible but it is essential that broad lines of policy be also laid down for the guidance of commercial interests.

121. Research and facilities for research are severely lacking in the country. The first effort should be to establish close contacts with Government, educational or commercial organizations in foreign countries that can assist in the matter. In England and America, research is generally carried out by commercial interests, and co-ordination and supervision of research work is done through the channels of associations, combines or technical institutions. Since we have recommended that Government take the responsibility of establishing proper facilities for research and education, it is suggested that the Government make extensive enquiries in various foreign countries through experts in respective lines or reputed firms of consulting engineers. Many manufacturers

are now willing to establish associate or subsidiary manufacturing organizations in Asiatic countries and it may be possible in the arrangements for establishing such manufacture in India to provide for collaboration in research also. The Panel is of the opinion that selection has not been made in the past of personnel for research of higher technical training in a satisfactory manner, and this question will be dealt with in detail at a later stage. It is here emphasised that to obtain proper co-operation and collaboration, it will be essential that the best available personnel be selected, and where certain minimum standard of qualification and experience is lacking, indifferent personnel should not be sent to foreign countries for research or higher technical education.

122. Establishment of manufacture in India in collaboration with foreign interests will naturally raise the question as to the proportion of foreign managerial and financial interests in local organizations. It is not considered practicable to lay down specific proportions or an outline of the extent to which foreign interests may be permitted to control the local industry. Much will depend on the industrial policy and attitude of the Government and commercial interests in other countries, together with the volume of trade that local industrialists can assure without appreciable deterioration in quality.

123. As a general policy, the proportion of foreign capital in local interests should be on a limited minority basis. It is likely that, particularly in the case of difficult and highly specialised items, foreign interests will not care to foster industry in this country without prospects of adequate return. The extent to which imported technical personnel should be utilised would also need to be varied according to the requirements of the individual industry. It may not always be a good policy to entirely eliminate foreign participation at the risk of not having the industry at all or postponing its establishment for a very long time. The aim should be to be independent of foreign technicians and management within a period not exceeding ten years.

124. It is worthwhile mentioning in this connection the policy followed by Russia. Each foreign technician had under him two or three Russian understudies and the foreign technician was required to train his substitute so as to turn over the entire responsibility to the selected substitute within a specified period. The foreign technician stayed in the country for a further specified period until the substitute achieved the required standard of efficiency and experience.

125. Collaboration with foreign manufacturers would involve in many cases payment of royalties for the use of patents.

126. Since Government have taken the initiative to foster the industrial development of the country, it is very necessary that Government also assist in negotiation by local commercial interests with foreign concerns in respect of any arrangements for establishment of subsidiaries or associate companies in this country. The negotiations for purchase of patent licences and working drawings could, with advantage, be channelled through some Governmental agency or Corporation associated with the proposed Industrial Finance Corporation. It should be possible to draw up a model agreement detailing the broad lines for the guidance of negotiators in such matters, so that commercial interests wishing to establish associations by direct negotiation do not plunge themselves into unhealthy enterprises owing to lack of experience or due to pressure and thus injure the broad national interests.

127. **Location of Industry.**—We have where possible suggested suitable locations whilst dealing individually with the various categories, machinery and equipment. Owing to the vastness of the country, the essential factor should be economic distribution of raw materials, particularly copper and steel, the sources for which are few and far apart. Since, the proportion of waste from the raw to the finished product is in this industry comparatively small, dispersal will not be a handicap. In fact it is considered that by dispersing the industry over a wide area better distribution and maintenance

facilities will be possible than would be the case by concentrating production and distribution centres. Due regard must however be paid in the location of industries to such considerations as size and nearness of markets, easy defence during times of war, enterprise of local inhabitants and availability of cheap power and other indispensable facilities. Since transportation in India is very expensive both in respect of time and money, it would be an advantage to separate industries involving light tonnage from those involving heavy tonnage and locate the former in inland towns and the latter in port towns.

128. Lack of skilled labour in the vicinity, housing and other facilities will frequently discourage establishment of industry in centres that would otherwise be more suitable. Lack of housing, sanitation and medical facilities in industrial centres in India is a severe handicap and needs special attention. If Government would provide these facilities we have no doubt that suitable skilled labour can be drawn even from distant places. It is essential therefore that certain minimum standards of comforts, medical and educational facilities, etc., should be laid down for all industrial labour and where necessary provided with the assistance of Government.

129. The Map at Appendix XII specifies our recommendations in respect of establishment of electrical industries keeping in view the conditions prevailing at present.

130. Development on Cottage Industry Basis.—Owing to a fairly high degree of technique required in the manufacture of most of the items of electrical machinery and equipment, it may be generally assumed that development on cottage industry basis can be applied with advantage in rare cases. "The only products that may be established on cottage industry basis are domestic appliances such as hot plates, immersion heaters, electric kettles, welding irons, lamp shades, table lamps, etc."

131. The principal raw materials and components required in the manufacture of domestic appliances consist of:

1. Ferrous and non-ferrous sheet metal pressings.
2. Ferrous and non-ferrous light castings.
3. Ceramic basis and resistance wire holders.
4. Bakelite and other moulded parts for terminal connections.
5. Nichrome and other resistance wires and strips.
6. Cloth, paper and galvanized iron wire for shades.
7. Timber for table lamps.

132. Sheet metal pressings are already made extensively in the country on cottage industry basis and may be developed further by providing assistance in improving design, quality and finish. In respect of certain items, tool room equipment for dies and presses may be needed. This also can be established on cottage industry basis for distribution over specified areas.

133. Ceramic parts could be made in bulk and distributed through Government channels. The same would apply to plastic moulded parts for which factories exist in Calcutta, Bombay, Lahore and Bangalore.

134. Resistance wire and strips could be imported and distributed through Government or trade channels.

135. Cloth, paper, galvanized iron wire and timber are already readily available all over the country.

136. For purposes of maintaining uniform and satisfactory quality products, a committee of engineers should be established for making initial investigations in regard to the industry. The composition of this committee should be as follows:—

1. One electrical engineer conversant with the manufacture of electric domestic appliances.

2. One mechanical engineer experienced in sheet metal pressings and light ferrous and non-ferrous castings.
3. A representative technician from Ceramic industry.
4. An engineer experienced in plastic moulding and production.
5. An engineer from a large utility concern conversant with the requirements of the market.

137. The functions of this committee should be:—

1. To select correct sizes and types of units under each of the above items of domestic appliances.
2. To design and make necessary working drawings.
3. To prepare schedule of materials.
4. To make a complete list of parts required and classify such parts under the following headings:—
 - (a) sheet metal pressing and castings,
 - (b) Bakelite moulded parts,
 - (c) Ceramic parts.
 - (d) Nickel and micanite and other insulating parts.
 - (e) Imported components.
5. To draw up specifications for the various materials and lay down minimum standards of quality and finish.
6. To specify tests by manufacturers to ensure satisfactory quality output.
7. To standardise equipment required for the manufacture of various products.

138. A directive should be given to this committee to see that the design is made as simple as possible, so as to facilitate assembly and bulk production. A little local touch in the shape and size, especially for items such as boiling kettles, hot plates, lamps, shades, etc., would be a strong point of appeal to the users of these appliances. The committee should complete the initial work expeditiously. Thereafter the Provincial and State Governments should establish Applications Committee whose functions would be mainly to keep abreast of progress and development in other countries. The expenses of such a committee could be wholly or partly met by charging a cess on the products.

139. After obtaining the report, drawings, specifications, etc., from the above committee, the Government should circulate them to the Directors of Industries of various Provinces and States with a view to elicit information from them as to what parts of the equipment could be made on a mass production basis by factories either Government or private in their territories.

140. The information received from the different Directors of Industries should be interchanged so that each one can supplement what the other cannot produce.

141. The industry should be run either by industrialists on a co-operative basis or by the Directors of Industries. They should select the best suited personnel for such type of work from among the artisans in their area and arrange for their necessary training in assembly and finish in jails, industrial schools, occupational institutes, etc. They would need to provide the artisans with tools, designs, raw materials and components for the production of chosen articles. Some of the finished articles would need to be brought to a convenient place for testing and that would be either the Electrical Department of the Province or State concerned or a local utility concern, there it would be given a thorough test, certified and stamped. The tested articles could be put on the market through the trade or a local utility concern or Government cottage industry show-room.

CHAPTER VI

Nationalization and/or Government Participation in Electrical Industries

142. Nationalization and/or Government Participation in Electrical Industries.—The Panel, throughout their deliberations, have generally been guided by the principle that private enterprise should be allowed fullest play in the development of electrical industries in this country and that any departure from this practice should be limited only to specific cases where the circumstances of an individual case justify, in the interests of the establishment of the industry, the adoption of a different course. The Panel, as constituted, have not given any extra consideration to the ideological or other considerations which influence public mind and Government policy in many spheres. The Panel have no desire to enter into any debatable points and have therefore decided to limit their recommendations so as to produce a more realistic report, to the sole and primary aim of earliest establishment of various electrical industries in this country on a sound basis.

143. Capital and enterprise have been coming forward to some extent in this field. With the general awakening and desire to industrialise the country, more capital and enterprise are likely to be devoted to the field of electrical industries. Yet we feel that on the whole electrical industries in the country are in their early stages and that there is room for Indian products to reach higher standards. However enterprise and capital are not likely to be forthcoming in the near future for certain sections of the industry without the active participation of Government. In the opinion of the Panel such sections, the establishment of which are essential and of basic importance for development of the industry as a whole, and more particularly where Government are the chief consumers, it is necessary that Government control or enterprise should step in at this stage. The following is the list of industries which fall under this category.

144. Telephones, Telecommunications, Teleprinters and relating equipment.—Government have adopted the policy of taking over commercial interests operating telephone and telecommunication services. The local manufacture of all equipment for such purposes should be established by Government on an economically sound basis. Government being practically the only purchaser of such equipment can accurately forecast their requirements over a long period and by acquiring rights to manufacture locally up-to-date equipment developed in foreign countries, can maintain a high standard of service at an economical cost. Government have, during war more particularly and even in peace-time, manufactured many items of such equipment in the telegraph workshops at Calcutta and have established similar schemes at Jubbulpore and Bombay presumably in consequence of benefits derived from past experience. It is not known whether Government's efforts to manufacture such equipment have been a commercially sound proposition, but we have no doubt that with the increased demand resulting from the schemes for expansion that Government have, they can establish the manufacture of telephone, telegraph and telecommunication machinery and equipment on a sound basis. This will lead to considerable indirect benefits to electrical industry and the country in general.

145. Signalling and Interlocking Equipment.—Manufacture of this also can be readily developed in the Railway Workshops by Government, as Railways are the main consumers and already have a nucleus organization that can be suitably expanded for manufacture of such equipment. Very little is known to the public in regard to Government's methods to commercialise such manufacture. It must be emphasised that for the scheme to be successful, the manufacture should be established so that proper standards of quality and efficiency are maintained at economic costs.

146. Insulating Materials.—This industry is in a very undeveloped state and it is necessary in the national interest that it should be started with minimum possible delay. In view of complications such as patent rights, continuous research, and heavy financial investment without prospects of proper return in the near future, commercial interests are not likely to undertake its development in the near future. Being a feeder industry, the future development of manufacture of electrical machinery and equipment will depend on local establishment of the industry on a sound basis. It is necessary that it is established under Government's aegis and commercial interests given a voice in respect of costs of manufacture, quality and distribution. This covers the following items:

- Tapes, cloth and tubings.
- Fibre, leatheroid, insulating paper,
- Press-pahn paper,
- Varnishes and oils.
- Cable jointing compounds.
- Mica and micanite products.

147. Cables and Wires.—There are some firms in India manufacturing cables and wires. However, their capacity is too small to meet the requirements of the country. Large quantities of cables and wires will be required in the future development of the country, both by Government and Commercial interests, and hence their manufacture should be encouraged and controlled by Government in the larger interests of the industry as a whole. Electrolytic copper and insulating materials are required in the manufacture of cables, wires, etc. We have at an earlier stage dealt with the question of development of processing of raw materials and the difficulties relating thereto. We are convinced that as a natural sequence further expansion of the industry should be undertaken either entirely by Government or interests largely controlled by Government by active participation. Economic supply for industrial purposes and high standard of quality are essential in these products.

CHAPTER VII

General Recommendations

148. Questions of subsidy, protection, preferential treatment, technical advice, research, etc., have been dealt with in the Chapter headed "Proposals". We specify here the broad lines of policy in respect of these for the guidance of Government. It is recognised fact that the country is industrially in a very backward state. In any scheme of future development the progress made by other countries over a period of several years would have to be achieved in a much shorter period. The additional handicaps arising from lack of top technical personnel, research facilities and the dependence on the imported specialised equipment, design, etc., add to the difficulties in establishing the industry on a sound commercial basis. There is no doubt, therefore, that assistance from Government in the shape of subsidy, protection, provision of facilities for specialised technical advice, research, etc., will play an important part. We have generally followed the policy of encouraging commercial enterprise and recommended initiative by Government only in such cases where the prospects of early return on investment and labour are not very attractive in the beginning and so commercial entrepreneurs would be reluctant to develop them. In countries like Canada, many industries have developed with the assistance of commercial interests in neighbouring friendly countries. In the case of India, its physical remoteness from the industrially advanced countries is a further handicap but it is hoped that by the increased facilities for air travel together with establishment of relations on a more equitable and rational

basis with highly industrial countries such as England and America, it will be possible to establish an interchange of technical knowledge, personnel and facilities.

149. Subsidy, Protection and Preferential Treatment to Indian Industry.—It is difficult to make a general recommendation for the grant of protection, subsidies, or preferential treatment to Indian industries at a time when world opinion, at least in the advanced countries, is veering round to a freer exchange of goods and removal of trade barriers. While India should aim at the achievement of this goal, placed as we are, we cannot shut our eyes to the realities of the situation which warrant that adequate and scientific protection should be given to some of the electrical industries, the fostering of which is essential both in the larger interests of the country and for defence. Discriminating protection, limited to a period of years, is what we recommend to be the best course to adopt. In the interests of the consumer and in order to stimulate the adoption of efficient methods of production by industries, both the grant of protection and its continuance should be subject to periodical checks by competent authority like the Tariff Board. While we are in favour, under the present conditions of granting protection, we also are not less conscious of the interests of the consumer or the great need for avoiding the tendency in protected industries to follow uneconomic methods and to lag behind in the struggle for improving their methods of production and cheapening their costs. The protection we command should therefore be of a temporary nature limited to a period of years, depending on the circumstances of each industry, after which the position should be reviewed carefully. The industrialists of the country should take extreme care to plan for expansion or new installations in a thorough manner, and devote all the energy possible to develop the industries undertaken by them rapidly and co-operate with Government to eliminate protection and assistance within as short a period as possible.

150. There are certain industries particularly in respect of raw materials processing, etc., that probably will remain a burden to the Government for a long period but there is no doubt that with proper planning and co-ordination, the financial encumbrances will steadily reduce, so as to be incon siderable compared to the advantages gained by establishment of basic and key industries in the country. Bearing in mind the factors involved we recommend that there should be an organisation established by Government for keeping constant watch on the industries receiving substantial assistance from Government to ensure that manufacturing costs are steadily reduced and that constant improvement is maintained in respect of design, quality, workmanship and standards of efficiency. The industries should realise that India can raise her standard of living only by increasing production, lowering costs and prices and extending markets.

151. The Panel is of the opinion that existing machinery and procedure of the Indian Tariff Board suffer by comparison with those elsewhere, firstly in regard to the temporary nature and secondly in regard to absence of power to initiate and sponsor changes suo moto. With a view to render prompt assistance to the growing industries of the country, the Panel strongly recommends the establishment of a permanent Tariff Board to which references may be made direct without the need to make an approach through other Government channels at all stages.

152. The India Government have for a number of years adopted the policy in regard to their purchases of giving preference to Indian products and it is emphasised that this policy should be continued. In the initial stages the products of Indian industries would need a certain amount of latitude by accepting lower standards of quality and workmanship but by periodical changes of specifications and testing standards, etc., the Indian industry

should be helped to maintain steady improvement. Further, Government should not enter into any long term commitments for purchase of materials required in connection with railway expansion, power development, etc., with foreign interests. Where, after thorough investigation, Government are satisfied that supply from local sources would not be possible within a reasonable period, it may be advantageous to enter into long term commitments but the possibilities of assisting the local industry by such suppliers should be explored. Government should give the widest possible publicity to its requirements for post-war development in all its branches with a view that the local industrialists prepare themselves to meet such requirements from the country's production to the maximum possible extent. The requirements should be so grouped that individual industries can readily adjust its production to meet them.

153. **Higher Technical Education and Research.**—The existing facilities in the country for technical education and research are known to be of a very poor standard and entirely inadequate for the needs of an industrially growing country. The educational facilities available in Indian Universities and Indian Institutions for electrical engineering come to the diploma standard and not to the degree standard of foreign Universities. This is a consequence of the educational policy followed in this country for many generations, but with the new vision of an industrialised and free India, the Panel strongly feel that it is essential for the purpose of industrialisation that the standard of education in this country be so raised that the products of our Institutions and Universities do not compare unfavourably with the products of foreign Institutions and Universities. This may involve importing temporarily a large number of technical experts and professors, but this price should be paid in the interest of general development.

154. Modern electrical industry is based on research and fabulous sums are spent every year by electrical institutions in Europe and America. With the Indian electrical industry still being on a small scale and in early stages, it would be difficult to expect it to undertake research on a vast scale or a comparative basis. It is therefore essential that the national laboratories which are likely to be set up by the Government should take care of this aspect of the problem. This should not, however, absolve the industrialists carrying their share of the burden. We cannot but emphasise, with all the strength and conviction at our command, that unless India invests more money in research and education it will be in vain to look forward to any era of industrialisation in this country.

155. While on this subject, the Panel feel that some liaison should be established between research in foreign countries in the electrical industry and research that may perhaps be carried on in Institutions in India. As overlapping should be avoided as far as possible and a problem that has already been solved in foreign countries should not be taken up again, recourse in such cases should be had to gain the knowledge by suitable arrangements with foreign firms and by using India's unique position as supplier of raw materials and as markets in foreign industrial countries for bargaining.

156. As we have stated at an earlier stage, the selection of trainees for research and higher technical educations has in the past not been made in a satisfactory manner. Dependence on examination results is not a reliable procedure for selecting the best available material. Admission to the technical institutions should be made on the basis of the prior educational career of the individual and the best available candidates should be encouraged to take up technical career rather than other remunerative services at an early stage in their life. Technical education is expensive and in the interest of drawing the best students without fear of a prolonged expensive training, scholarships should be generously given to deserving candidates. The progress of every student should be closely watched both in theoretical and practical work so

that the student's attention is diverted at an early stage to specialising in manufacture design or research in accordance with the aptitude shown by the student. The Panel are aware of Government's proposals for regional technical institutions and emphasise that their establishment should be hastened.

157. The American experts have emphasised the complete lack of "know how" amongst the technicians of the country. "Know how" is defined in their report as:

"The intimate knowledge of the most practical means under any given, condition to produce in quantity at lowest cost and involves knowledge of methods of processing, tooling and designing of jigs and fixtures, the lay out of equipment and the provision of labour saving devices, the designing and setting up of proper controls of production and inventories; the organisation of supervisory personnel and laying down lines of authority and responsibility."

158. It will be seen that it is very essential to take care of this factor at every stage in technical training, research and co-ordination.

Technical Advice and Personnel type

159. **Purchasing Agency for Patent Rights.**—The American experts Messrs. Ford, Bacon and Davis, U.S.A., who were asked by the Government of India to report on the 'Manufacture of Industrial Machinery and Equipment in India' have stated as follows:

"Industrialisation in India would be expedited if the designs worked out in other countries could be secured for manufacture in India with such modifications as may be necessary to adapt the products to the peculiar conditions existing. Many products are protected in other countries by patents but generally it is possible to negotiate for the use of patents, licences and to acquisition of working drawings and specifications. It would seem, in order to facilitate negotiations for such rights and privileges, that they should be channelled through some Governmental agency rather than to let each industrialist carry on individual negotiations. We think, therefore, it is of great importance to your overall plans that such an agency be formed."

160. The Panel entirely agree with the above view. However, it is possible that in many cases negotiations already instituted individually by local industrialists may have advanced far too far for Government to intervene at this stage. This would not eliminate the necessity for establishing an "Industrial Corporation" for the purposes of negotiating the purchase of designs, patents, licences, working drawings, etc. The local industrialists who have already made satisfactory progress in their negotiations may be allowed to finalise their arrangements without Government intervention if they so desire.

161. We have suggested at an earlier stage that Government should draw up a standard agreement or broad basis of agreement giving due regard to the interests of the country so as to prevent foreign interests taking root locally to the detriment of the industries in the hands of the nationals of the country. This Panel recommends establishment by Government of an Industrial Corporation in which commercial interests should have adequate voice. The functions of the Industrial Corporation will mainly be to provide necessary capital, where capital from commercial sources is not forthcoming readily, after satisfying themselves that assistance from foreign interests is essential and that the arrangements by local interests are commercially sound. It may become a tendency in the country to draw foreign capital and management with nominal local interests and establishment of such organisations should be definitely discouraged.

162. **Consulting Engineers.**—In many highly developed products involving high degree of technique and complicated process of manufacture, there will be need for constant reference to experts on technical matters. There will be

many industries such as manufacture of X-ray equipment, television, electrical microscopes, high frequency furnaces, etc., in the manufacture of which advice from expert consulting engineers will be of considerable assistance. Government should therefore make necessary investigations and appoint specialists in the form of foreign concerns or individual technicians, or a Board of technicians to which the industry could make reference at various stages of the development to overcome the difficulties they may experience. Whatever the organisation the essential factor should be that they are able to advise on both design and manufacturing difficulties and in some cases also in investigating suitability of raw materials available from local sources. It is not necessary to enumerate the type of products or specify the nature of technical assistance, as much will depend on the extent and competence of technical assistance and personnel employed by industrialists in the organisations they set up.

163. Availability to Trade and Industry of Expert Advice from Government Personnel.—We have suggested in the preceding paragraph appointment of consulting engineers which would naturally be a somewhat expensive set up. However, Government can make available to the trade and industry expert advice from personnel, employed in their organisation for normal development. For example, in connection with hydro-electric expansion, Government have provided training abroad of their officers at considerable expense to public exchequer. There is no reason why the Department concerned should not so arrange the training and selection of their expert personnel, whether of local or foreign origin, that such personnel be capable of providing technical assistance to trade and industry also. Somewhat similar scheme should be possible in respect of telephone, telecommunications, teleprinters, radio, signalling and interlocking railway equipment as the Departments concerned normally need to engage experts for efficient management. The Panel is therefore of the opinion that Government should make necessary provision in their future schemes and announce to the public the nature of assistance that such personnel can provide wherever satisfactory arrangements are possible. For example Government can provide considerable assistance to the electrical industry by manufacturing for them taps, dies and gauges, etc., in the Ordnance Factories which are at present the only suitable organisations in the country capable of manufacturing these products.

164. Specifications and certificates.—The proposed Indian Standards Institution should co-ordinate the Indian Stores Department, Indian Railways and Ordnance Specifications and draw up Indian Standards Specifications, which should be exclusively followed by all Government Departments and industrial concerns. The Institution should endeavour to standardise finished products so as to meet the climatic and economic conditions of the country together with maximum utilisation of locally available raw materials.

165. The Panel notes with satisfaction that the Government have decided to establish a National Physical Laboratory in India. This organisation can be a nucleus for establishing extensive research and assisting in standardising suitable designs, specifications and raw material substitutes in accordance with the needs of the country.

166. In addition there should be an Inspection Organisation as an extension of the existing Inspection Wing of the late Indian Stores Department, for certifying the quality of certain Indian products. This inspection, together with extensive publicity to educate the general public to insist on certain minimum standards of quality, will give considerable impetus to improving the quality of the Indian products. It will therefore be necessary for the Inspection Organisation to undertake inspection and certification on behalf of commercial organisations. This is being done to a certain extent in respect of supplies of steel and has been found to be of considerable assistance in educating the public to call for proper quality of steel for the purpose required.

Initiative by Government:

167. Electrical Machinery and Equipment Board.—(i) It will be seen that there are many difficulties and handicaps in giving practical shape to the Panel's recommendation. The Panel is of the opinion that the development of the industry should be actively and persistently followed and certain amount of technical assistance should be readily available as and when difficulties are experienced. With this object in view the Panel recommends establishment of an Electrical Machinery and Equipment Board under the auspices of Government.

(ii) The Board should have the following two Panels: (i) Light Electrical Industries Panel and (ii) Heavy Electrical Industries Panel. The members of the Board and Panels should be drawn from industrial associations, the proposed National Physical Laboratory for India, Indian Standards Institution and such other organisations as are vitally interested in or connected with the development of electrical machinery and equipment industries of India.

(iii) The Board should be an advisory body to the Government in regard to policies to be adopted for the development of electrical machinery and equipment industries. Government should also utilise this agency in exercising necessary checks on production costs, standards of quality and workmanship, investigations in regard to raw material substitutes, etc.

(iv) We have already elsewhere pointed out the appalling lack of statistics in the country and it should be one of the essential functions of the proposed Electrical Machinery and Equipment Board to advise Government on the form of statistics to be maintained in respect of production, import and export. The collection and publication of such statistics will still be the function of the present Government organization. However it is suggested that facilities should be provided to employees of industries to obtain training in the matter of collecting statistics. This we understand is the practice of the Board of Trade in England. Statistics for imports, exports and local production should be maintained not only in rupee values but also in numbers or weights by specified types and classes of machinery and equipment.

168. Transport.—The existing system of freight rates on raw materials and finished products is presenting difficulties to the electrical industries in the way of excessive incidence of freight costs arising from long haulages. We strongly recommend introduction of telescopic and sliding scale of rates for long haulages related to quantum of materials offered for despatch every month. Railways should also provide better siding and handling facilities in industrial centres as stated before.

169. Deputation to foreign countries.—It will be seen from our recommendations that considerable assistance from foreign countries is needed for the establishment and development of indigenous industries. Whilst it will be essential to establish individual contacts after the initial stages of planning are over, the Panel is of the opinion that considerable initial work and establishing of friendly relations would be achieved by sending a deputation of industrialists, educationists, technicians and scientists connected with electrical industries to foreign countries. The members of this deputation should be conversant with the needs of the country in respect of raw materials, equipment, technical personnel, etc.,

The deputation should study and make recommendations on:

- (a) Suitable schemes for providing technical education and research facilities in India.
- (b) Arrangements for obtaining raw materials, equipment, technical personnel, etc., from foreign countries.

(c) The American experts have emphasised the lack of "know how" and the deputationists should make a special study of how such knowledge can be developed in this country, and

(d) Such other functions as Government might consider proper.

170. Time-Table for the First Five years' Development.—The first five years' plan for the development of electrical machinery and equipment industries as can be visualised today is outlined below. The first two years will have to be a preparatory period during which most of the preliminary work of orienting the line of development of new industries, establishment of Indian Standards Institute, National Physical Laboratory for India, Testing Laboratories, etc., will have to be taken up. Starting from the third year the concrete results of planning will manifest themselves in increased production and the variety of manufacture.

171. First year.—1. Formation of an Electrical Machinery and Equipment Board to assist the Government.

2. Government to collect factual data in details regarding imports, exports, productive capacity of the country, actual production, etc.

3. Early establishment of suitable technical educational institutions, the National Physical Laboratory for India and Testing Laboratories, etc.

4. Establishment of the Indian Standards Institute for drawing up specifications and establishing standards.

5. Examination of existing Tariff Policies and incidence of import duties and granting of protection and subsidies to indigenous electrical industries.

6. Ordering of most of the capital goods required in case of certain industries.

7. Importing of necessary technical personnel from abroad.

172. Second Year.—1. Surveying the work done during the previous year and appraising the value thereof. It should be better to correct the faults and revise the policies during the initial stages of development rather than allow the mistakes to accumulate over a long period of time. This survey should be made every year and duly reported.

2. A survey of the installation of the capital goods ordered during the previous year.

3. A survey of the work done by the various Institutes established during the first year.

173. Third, fourth and fifth years.—As a result of the work done during the first two years it should be possible to complete the erection of new plants and begin production at least during the third year, if not earlier. The Government Agencies like the National Physical Laboratory, Testing Laboratories, etc., should also be able to give more help to the industry during the third year. In fact, starting from the third year the concrete results of planning should become manifest.

174. During the third year it should be possible to make preliminary plans for the second five-year stage and it should be possible from the experience so far gained to arrive at definite ideas about future planning.

CHAPTER VIII

Summary of the Report

175. Electricity has a wide application for domestic, industrial, agricultural, sanitation and medical purposes. Hence it is of fundamental importance in the larger interests of the country that the industries connected with generation and utilisation of electricity are developed to the maximum possible limits.

176. The basic requirements of power, labour and transport facilities exist and there is considerable scope for their development. In regard to raw materials lack of processing facilities can be overcome by proper planning and Government participation. It is necessary that an integrated programme of development of power, labour, transport together with technique and education is introduced with minimum possible delay so as to establish a key industry of such importance in the country with minimum possible delay.

177. For purposes of proper planning it is necessary that statistical data is readily available and its complete lack has been a serious handicap to the Panel. The Board of Trade in England maintains statistics, technical data and contacts with research developments for the benefit of the industry. It is suggested that Government Organization in India should take up similar responsibilities in these matters. The survey by this Panel, has owing to lack of statistical data, been confined to estimates arrived at on a rational basis in respect of the post-war demands.

178. The Panel have, for purposes of their investigation, classified industries in two categories, viz., (1) Heavy Electrical Industries and (2) Light Electrical Industries. Both categories of the industry are in a backward state despite the impetus of two World Wars and considerable interest shown by commercial enterprise. Only certain sections of the industry such as lamp, fan, battery, electric motors and transformers have come into being but further developments on sound commercial basis is possible only through assistance and participation by Government, particularly in respect of processing of raw materials and manufacture of insulating materials.

179. Increased electricity generation together with improved telephone, telegraph, tele-communication and transport services, expansion or establishment of new industries such as cotton-textiles and automobile industries, and agriculture will provide ample scope for the products of the electrical industry in India. Government should make available to the industry details of their requirements classified by types, quantity and target dates so that the Indian industry are in a position to formulate their plans to meet these requirements.

180. The Heavy Electrical Industries have been given the first priority in the development programme specified by the Panel so that the expansion of other industries like electric supply, railways, telephones, telegraphs, etc., is stimulated. The Panel have been unable to obtain necessary data in respect of all industrial developments. Capital requirements for a few industries, where such data was available, amounts to approximately Rs. 8.5 crores and that of capital goods to approximately Rs. 3 crores. A better idea of capital requirements will only emerge after the first five year period which is on the anvil.

181. In respect of Light Electrical Industries, development in the past has largely, due to competition from countries like Germany and Japan, been very poor and unsatisfactory. Manufacture of a few items under this category can be established on cottage industry basis. Whilst we have indicated such items as lend themselves readily to manufacture on this basis, actual selection and establishment of manufacture will rest with Government. Here again, it has not been possible to frame accurately estimates of capital requirements on the data made available. It is estimated that for some of the industries the capital requirements shall be in the region of Rs. 2 crores. Requirements of capital goods under this category will be relatively small as considerable development can take place on cottage industry basis. Certain industries such as manufacture of valves, X-ray equipment, air-conditioning, cold storage and refrigerating equipment would require large capital and capital goods but the Panel is not in a position to furnish any estimates for the same.

182. Owing to the industrial backwardness of the country the Panel recommend the grant by Government of assistance in the form of protection, preferential treatment or subsidy. The Panel have, however, in their recommendations emphasised that such benefits should be restricted to a specified period subject to the periodical re-examination of the position. It is necessary that the industrialists keep abreast of progress in foreign countries and not lag behind in their methods of production or manufacturing costs so as to be a burden to the consumers. For this purpose facilities for extensive and efficient high technical education would need to be provided in the country as soon as possible. Adequate top technical personnel for purposes of research and development of the industry should, where necessary, be imported but the aim should be to eliminate same in as short a period as possible. The Panel recommend that Government should provide facilities for research on an extensive scale in co-ordination with the industry, as the electrical industry of India in the present state cannot afford the capital required for research and new developments on a scale that foreign countries are in a position to do.

183. The products of the country have hitherto not been of high standard of quality and Government should arrange to draw up standard specifications and provide extensive facilities for inspection and certification so that constant improvement in the quality of indigenous products is maintained.

184 The Panel have recommended establishment of Electrical Machinery and Equipment Board with a view to stimulate development and facilitate co-ordination between Government and the industry

185. The targets for development specified in the body of the report are summarised in the attached statement together with the Panel's recommendations in regard to tariff, subsidy, or other assistance.

By the unanimous consent of the members.

New Delhi,

The 23rd April, 1947



G. M. MOHAMMED.

1	2	3	4	5	6		7	8	9
Industry	Estimated annual consumption during the first five year period	Present annual production capacity	Annual Production target to be aimed at during the first five year period	Capital required for production recommended during the first five years (In Rs.)	Capital goods required for production recommended during the first five years		Tariff or subsidy	Factories exist in	Further factories to be established in
					To be imported	To be obtained locally			
					Rs. (a)	Rs. (b)			
1. Motors and Generators :									
(a) A. C. 3-phase slipring motors	4,500 Nos.	..	1,000 Nos.	2½ crores	60 lakhs	15 lakhs	Duty on raw materials to be reduced to the level of finished product	Calcutta Bombay Lahore Kirkoskarvadi Coimbatore	Calcutta Bombay Lahore Bangalore Tatanagar Madras Peshawar Karachi Dibrugarh
(b) A. C. fractional H. P. motors.	18,000 Nos.	..	3,000 Nos.						
(c) A. C. 3-phase squirrel cage motors	75,000 Nos.	75,500 Nos.	35,000 Nos.						
(d) A. C. starters	60,000 Nos.	..	40,000 Nos.						
(e) A. C. generators.	4,000 Nos.	..	1,000 Nos.						
2. Transformers	300,000 KVA	80,000 KVA	250,000 KVA	Very limited	10 lakhs	...	Do.	Calcutta Bombay Lahore Bangalore	Calcutta Bombay Lahore Bangalore Tatanagar Madras Peshawar Karachi Dibrugarh

[illegible]

	Rs. 4 crores	Very limited Rs. 2 crores	4 crores	65 lakhs	60 lakhs.	...	Calcutta Bombay Bangalore Lahore	Calcutta Bombay Bangalore Lahore Tatanagar Madras Peshawar Karachi Dibrugarh
(b) Manually operated discon- necting switches.								
(c) Simple type switchboards								
(d) Fabricated switchboards								
(.) Circuit break- ers.								
5. Insulators .	5,000 tons	1,000 tons	5,000 tons	Not known	..	..	Calcutta Bangalore Gwalior Delhi Morvi Poona	..
6. Electrical Measur- ing Instruments:	300 000 Nos.	Very limited	100,000 Nos.	25 lakhs.	15 lakhs	..	Bombay Nagpur Cawnpore Hyderabad (Dn.) Lahore	
7. Radio sets & Equipment	400,000 Nos. high pow- er & act and 100,000 Nos. cheap sets	.	400,000 high powered sets and 100,000 cheap sets	Limited	..	Duty free import of valves re- commended	Bombay	Calcutta Bangalore Karachi
8. Electric lamps	18 million lamps.	15 million lamps.	31 million lamps.	..	..	Duty free import of all raw ma- terials and components to be con- tinued.	Calcutta Bombay Karachi Mysore Patna Shikohabad	..
9. Electric fittings .	Rs. 40 lakhs	Limited	Rs. 40 lakhs	Limited.	Very small	..	Calcutta Bombay Lahore	Karachi Cawnpore Hyderabad (Dn.) Bangalore

1	2	3	4	5	6		7	8	9
					(a)	(b)			
10. Storage batteries.	150,000 Nos.	150,000 Nos.	200,000 Nos.	...	...		Existing duty to be adequately increased. Subsidy to be given to the local industry to bring down the price of raw materials to the level of that in U.K. and other foreign countries. Same remarks as for storage batteries.	Calcutta Bombay Bangalore	Lahore
11. Dry batteries	500 million cells.	500 million cells.	750 million cells.	...	...	...		Calcutta Bombay	Lahore
12. Fans	150,000 Nos.	150,000 Nos.	200,000 Nos.	...	...	...	...	Calcutta Bombay Lahore Amritsar	...
13. Electric domestic equipment.	Rs. 40 lakhs	Little	Rs. 40 lakhs	Very limited	Very limited	...	Duty free import of nichrome wire to be permitted.	Calcutta Lahore Bombay	Calcutta Bangalore Peshawar Hyderabad (Hn.) Cawnpore Karachi

In regard to rest of the items, the industry being in an elementary stage of development a proper picture cannot be obtained by a statement of this type.

APPENDIX I.

GENERAL DIRECTIVE TO INDUSTRIAL PANELS

1. It is the function of panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities, as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations, panels will be supplied, as far as possible, with factual information prepared by the panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive; it will indicate, in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each panel, as a basis, for discussion, the provisional target to be aimed at in the first five-year period and, wherever possible, of the target to be reached in 15 years.

3. The recommendations of the panels should cover the following points:—

- (1) The scope and extent of development, including the type of products recommended.
- (1-A) The estimated requirements of capital goods together with such details of those requirements as may be available in India and how much should be imported from abroad.
- (2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.
- (3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.
- (4) The extent to which technical advice from abroad may be necessary. a
- (4-A) The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present short-comings and future needs.
- (5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.
- (6) The location of the industry.
- (7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.
- (7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw material from which they can be manufactured.
- (8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.
- (9) What should be the organisation of the different units of the industry, *e.g.*, should there be an industrial association? Would a cartel be desirable?
- (10) The stages by which the industry should be developed.
- (11) Should the industry cater for the export market?
- (12) Should the industry be developed, as in Japan, on the cottage industry basis and, if so, to what extent?

4. Although, as stated above, the panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

5. Joint meetings of the panels should be held, wherever necessary, to secure co-ordination particularly where the processes and the products of one industry are connected with those of another.

6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

7. Before submitting recommendations, panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Government/Durbar. The recommendations should be submitted to Government through the Industrial Adviser.

APPENDIX II.

LIST OF ELECTRICAL MACHINERY & EQUIPMENT

A. Heavy Electrical Stores.

1. Motors and Generators:—

- (a) 3-Phase slip-ring motors.
- (b) Fractional horse power motors
- (c) 3-Phase squirrel cage motors.
- (d) Motor starters.
- (e) A. C. Generators.

2. Transformers and Condensers.

3. Electrical Cables and Wires.

- (a) Bare copper conductors.
- (b) Aluminium conductors.
- (c) Rubber insulated cables.
- (d) Insulated winding wires.
- (e) Other types of cables.

4. Switchgears.

- (a) Knife switches and fuses including iron clad, domestic and industrial switchgear.
- (b) Manually operated disconnecting switches.
- (c) Simple type switchboards.
- (d) Fabricated Switchboards
- (e) Circuit breakers.

5. Transmission and Distribution Poles and Pole Fittings.

6. Insulators.

7. Electrical Measuring Instruments.

- (a) Ammeters.
- (b) Voltmeters.
- (c) Wattmeters.
- (d) House service meters.
- (e) Meters of other types.

8. Signal and Interlocking Instruments.

9. Factory Electrical Equipment.

- (a) Electrical sirens and hooters.
- (b) Soldering irons.
- (c) Electric hoists and cranes.
- (d) Lifting magnets.
- (e) Magnetic separators.
- (f) Magnetic chucks.

10. Miscellaneous Electrical Equipment such as Furnaces and Ovens and Hospital Electrical equipment.

11. Electric Welding plants, Accessories and Electrodes.

12. Refrigerator and Air-conditioner equipments.

B. Light Electrical stores

1. Radio sets and equipment.

- (a) Receiving sets.
- (b) Transmitting sets.

2. Electric Lamps.

- (a) General service type lamps.
- (b) Train, cab and auto-car lamps.
- (c) Switchboard and telephone board lamps.
- (d) Torch bulbs.
- (e) Neon and fluorescent lamps.

3. Electric Fittings.

- (a) Switches.
- (b) Ceiling roses.
- (c) Fuses.
- (d) Distribution switchboards.

4. Storage and Dry Batteries.5. Electric Fans.

- (a) Ceiling fans—A. C. and D. C.
- (b) Table fans—A. C. and D. C.
- (c) Carriage fans.
- (d) Exhaust fans—A. C. and D. C.

6. Electric Domestic equipment.

- (a) Heaters.
- (b) Kettles.
- (c) Irons.
- (d) Ovens.
- (e) Any other type of equipment.

7. Automobile Electrical equipment.8. Telegraph and Telephone equipment.9. Dairy Electrical equipment.10. Electrical Sound Recording equipments.11. Insulating materials.

- (a) Tapes, cloth and tubings.
- (b) Fibre, leatheroid, insulating paper and presspahn paper.
- (c) Varnishes.
- (d) Cable jointing compounds.
- (e) Mica and micanite products.
- (f) Others.

APPENDIX III.

No. EM-6(1).

GOVERNMENT OF INDIA

DEPARTMENT OF PLANNING AND DEVELOPMENT,
OFFICE OF THE INDUSTRIAL ADVISER.

NEW DELHI,

Dated the , March 1946

From

The Industrial Adviser, to the Government of India.

Delhi.

To

SIRS,

SUBJECT :—Post-War development of the Manufacture of Electrical Machinery and Equipment.

I am directed to state that one of the Panels recently set up by the Government of India will consider the manufacture of Electrical machinery and equipment in the country.

A list of machinery and equipment with which the Panel will be concerned is enclosed (*vide* Appendix A)

In order to prepare the ground for the recommendations of the Panel, the Government of India wish to have as complete a picture as possible of the Indian manufacture of electrical machinery and equipment, as is to-day and of the position in which it is likely to find itself in the near future. For this purpose, a questionnaire has been drawn up and a copy of which is enclosed (*vide* Appendix B). It will be observed that the information asked for not only relates to facts and figures (most of which are not obtainable from existing official publications) but also invites your views as to the future development of the industry. The Government of India are anxious to secure the closest association of the industry with their post-war industrial plants and they look forward to your co-operation in the work of this industrial panel.

It is appreciated that it may not be possible for you to furnish replies on all the points in the required form. In that event, you are requested to furnish them in such a form as may suit you, although it will be very much appreciated if you can adhere as closely as possible to the form of the questionnaire. Any information furnished by you will be treated as confidential, if you so desire.

I am to request you that if possible your replies may be furnished within one month from the date of receipt of this letter. A copy of your reply may at the same time be forwarded to the Provincial Government of your Province.

Receipt of this letter may kindly be acknowledged.

I have the honour to be,

SIR,

Your most obedient servant,
for *Industrial Adviser*.

APPENDIX A.

LIST OF ELECTRICAL MACHINERY AND EQUIPMENT

1. Motors and Generators :—

- (a) 3-Phase slip-ring motors.
- (b) Fractional horse power motors.
- (c) 3-Phase squirrel cage motors.
- (d) Motor starters.
- (e) A. C. Generators.

2. Transformers and Condensers.

3. Cables.

- (a) Copper conductors.
- (b) Aluminium conductors.
- (c) Enamel, S. C. C., DD. C. C. and D. S. C wires.
- (d) Rubber insulated cables.
- (e) Other types.

4. Switchgears.

- (a) Knife switches and fuses.
- (b) Circuit breakers.
- (c) Disconnecting switches—manual.
- (d) Simple type switchboards.
- (e) Fabricated switchboards.

5. Radio sets and equipments :—

- (a) Receiving sets.
- (b) Transmitting sets.

6. Electric Lamps :—

- (a) General service type.
- (b) Train, cab and auto-car lamps.
- (c) Switchboard lamps.
- (d) Torch bulbs.
- (e) Neon and fluorescent lamps.

7. Electric Fittings:—

- (a) Switches.
- (b) Ceiling roses.
- (c) Fuses.
- (d) Distribution switchboards.

8. Transmission and Distribution Poles and Pole Fittings.9. Storage Batteries.10. Dry Batteries.11. Insulators.12. Electrical measuring instruments:—

- (a) Ammeters.
- (b) Voltmeters.
- (c) Wattmeters.
- (d) House service meters.
- (e) Meters of any other type.

13. Signal and Interlocking Instruments.14. Electric Fans:—

- (a) Ceiling fans
 - A. C.
 - D. C.
- (b) Table fans
 - A. C.
 - D. C.
- (c) Carriage fans.
- (d) Exhaust fans A. C. and D. C.

15. Electric Domestic equipment:—

- (a) Heaters.
- (b) Kettles.
- (c) Irons
- (d) Ovens.
- (e) Any other type of equipment.

16. Electric Furnaces and Ovens.17. Hospital Electrical Equipment and Apparatus.18. Automobile Electrical Equipment:—

- (a) Plugs.
- (b) Distributors.
- (c) Condensers.
- (d) Horns.
- (e) Dash board equipment.
- (f) Direction signs, etc.

19. Factory Electrical Equipment.

- (a) Lifting magnets.
- (b) Magnetic separators.
- (c) Magnetic chucks.
- (d) Soldering irons.
- (e) Electric hoists and cranes.
- (f) Electric sirens and hooters.

20. Electric welding plants, Accessories and Electrodes21. Telegraph Instruments and Equipment.22. Telephone Instruments and Equipment.23. Dairy Electrical Equipment and Apparatus.

24. Telecommunications and Radar :—

- (a) Collins transmitting and receiving man pack sets.
- (b) Animal pack sets.
- (c) Teleprinter and auto-high speed spares.
- (d) Plan position indicator items.
- (e) V. H. F. Aerial assemblies.
- (f) V. H. F. Receiving and transmitting sets, etc.

25. Electrical Sound Recording Equipment.26. Refrigerator and Air-Conditioner Equipment.27. Insulating Material :—

- (a) Tapes, cloth and tubings.
- (b) Fibre, leatheroid, insulating paper and presspahn paper.
- (c) Varnishes.
- (d) Cable jointing compounds.
- (e) Mica and micanite products.
- (f) Other types.

APPENDIX B

QUESTIONNAIRE

1. What types and sizes of Electrical Machinery and Equipment are now manufactured by your company?
2. Total production per annum in numbers and value of each of the principal products of your company—
 - (a) in the year 1937,
 - (b) during the war period (1939—1944),
 - (c) in any other year which the industry considers typical.
3. (a) Location of the factory.
 (b) The year in which it was established.
 (c) Is the industry localised in one or more regions and if so, are there any special reasons for it?
 (d) Are there any particular regions where the industry could be suitably localised, taking into consideration, the proximity to markets, availability of raw materials, power, labour, etc.?
4. Raw materials required for the manufacture of different products including different kinds of steels, ferrous and non-ferrous metals and other ingredients—
 - (a) Quantities of each kind and type of material used per annum. Clearly indicate against each item, the country of origin and the address of the suppliers.
 - (b) Do you experience any difficulties in obtaining your raw materials?
 - (c) Are the present facilities for transportation of raw materials to your factory adequate?
5. Plant and Equipment now employed :—
 - (a) Give a full list of machinery installed in your factory and state the makers, name, the country of origin, the year of manufacture and cost against each machine.
 If the machine was purchased second hand, an approximate estimated age of the plant may be indicated.
 - (b) What is the present condition of the plant?
 - (c) Additions and alterations to plant contemplated.
 - (d) Is any difficulty experienced in the upkeep and maintenance of your plant?
6. Labour conditions :—
 - (a) What is the strength of skilled and unskilled labour employed in your factory?
 - (b) What is the strength of supervisory staff employed? How many of them have received specialised training and where they have been trained?

- (c) Do you need any assistance from Government for providing technical experts and advise you regarding the process of manufacture and training of your staff? If so, indicate the precise nature of assistance required.

7. Production and Sales organisation :—

- (a) What is the post-war consumption of the products of your factory?
 (b) How and where you market them?
 (c) Do you possess your own sales organisation or you employ other firms to sell your products?
 (d) Is there a reasonable constant demand in the market for your products?
 (e) The scope and extent of future developments you contemplate for your industry by way of increased production or for manufacture of other types of machinery not so far manufactured.

8. Please state if, in your opinion, it is feasible to develop the manufacture of any basic component parts of your products on cottage industry lines, if so, how is such manufacture to be organised?

9. (a) What is the amount of capital of your company and how much more do you contemplate to spend on immediate and future developments? What is the capital expenditure incurred so far on land, buildings and machinery? Figures may please be shown separately against each item of expenditure.

(b) What amount of foreign capital, if any, is now invested in your company?

(c) Are your future capital requirements likely to be met by public investment in India? If not, how do you propose to meet them?

10. Do you need any protection or assistance from Government at present? If so, the same may be specified.

Are you aware of any protection given by Governments in other countries to industries such as yours? If so, please furnish details.

11. Do you desire any Government control of your industry hereafter with a view to assist its general development?

12. Do you employ any expert technical advisers from abroad and will continue to need them thereafter?

13. In case the future development of your industry depends on technical advice, patents and plants from foreign firms, how do you propose to obtain them?

14. Would you welcome forming an association of indigenous manufacturers using similar raw materials or producing similar products as your own, with a view to have a planned production and marketing?

15. Do you consider it possible for certain types of Electrical Machinery and Equipment to be built under licence with British or American firms which would enable Indian manufacturers to get expert guidance from parent concerns and produce articles to modern designs and of reliable quality?

16. Any other information for the guidance of the Panel will be appreciated.

APPENDIX IV
Statement Showing Import of Electrical Machinery and Equipment for the period 1935—1945
 (Value in Thousands of Rupees.)

Item	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
1. Motors	42,35	35,25	45,92	63,12	41,71	32,90	53,34	43,97	42,23	67,15
2. Transformers	19,00	19,66	26,23	25,63	21,93	19,12	17,84	13,44	28,31	53,64
3. Condensers	36	49	48	63	75	70	1,52	1,41	1,34	3,00
4. Cables (Bare copper wire).	10,77	14,52	10,29	17,52	14,07	9,44	13,03	6,53	5,04	2,29
5. Rubber insulated cables	29,16	31,98	42,38	47,69	42,13	37,03	19,41	23,42	24,96	61,05
6. Cables insulated other than rubber	50,95	43,57	64,79	65,95	57,12	54,14	44,44	31,88	31,74	53,63
7. Switchboards	4,14	3,10	4,73	5,11	3,20	2,08	3,55	2,53	1,72	2,75
8. Wireless apparatus	28,30	35,20	47,70	41,15	49,81	44,29	52,50	30,75	19,94	13,22
9. Lamps G. F.	19,43	16,38	19,94	14,62	12,41	8,40	11,66	12,05	11,06	21,70
10. Lamps Vacuum	18,58	12,50	15,77	9,88	10,38	9,29	10,34	5,00	2,29	4,96
11. Torch bulbs	2,84	3,23	2,88	2,48	2,59	2,52	2,06	95	1,33	2,26
12. Automobile bulbs	1,02	91	1,17	1,03	95	1,36	2,03	79	48	83
13. Electric Fittings (including switches)	8,11	6,45	7,68	6,95	7,04	6,48	8,64	4,16	2,96	4,40
14. Batteries	20,61	25,73	25,20	21,52	22,80	8,87	1,60	5,37	1,70	3,06
15. Electrical Porcelain Ware	...	...	1,33	1,35	1,40	1,17	1,46	56	48	1,78
16. Meters	10,46	11,39	11,93	12,81	14,12	10,09	20,94	8,14	3,63	£4,92
17. Fans	32,51	35,16	31,07	25,10	18,64	14,27	11,66	10,53	7,69	1,93
18. Electric Medical apparatus	5,00	3,64	6,53	4,96	5,32	5,92	9,92	3,46	2,75	5,83
19. Telegraph & Telephone instruments	£17,50	19,20	£22,39	22,61	12,69	13,44	15,39	16,33	11,98	23,39
20. Electric Sound Recording Equipment	...	3,29	5,73	3,95	2,25	3,93	4,52	1,22	41	1,87
21. Refrigerating Machinery	14,63	15,55	£28,29	13,87	21,24	17,99	20,47	2,66	6,74	5,41
22. Control & Switch Gear	44,35	48,82	54,83	90,05	59,83	49,32	62,62	61,58	55,28	77,71
23. Generators, Alternators, and Dynamos	21,59	39,78	25,90	36,97	26,30	16,36	22,49	24,68	29,44	30,59

APPENDIX V

Statement Showing Imports of Electrical Machinery and Equipment for the period 1935-45 Adjusted to 1935 Price level of the basis of Index of Prices (see copy).
(Value in Thousands of Rupees.)

Item	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45
1. Motors	42.35	28.20	35.50	45.60	37.00	26.30	38.62	29.20	26.00	38.25
2. Transformers	19.00	18.50	20.32	18.60	19.50	15.60	12.95	8.96	17.60	36.30
3. Condensers	36	46	37	48	66	56	1.10	94	82	1.71
4. Cables (Bare Copper wire)	10.77	13.69	7.96	12.69	12.50	7.55	9.50	4.35	3.10	1.31
5. Rubber insulated cables	29.16	30.10	32.70	34.50	37.40	20.60	14.10	15.60	15.30	34.80
6. Cables insulated other than rubber	50.95	41.1	50.10	47.75	50.75	43.30	32.20	21.20	19.50	30.60
7. Switchboards	4.14	2.92	3.68	3.70	2.84	1.66	2.58	1.68	1.05	1.57
8. Wireless apparatus	28.30	33.20	36.95	29.60	44.20	35.40	38.05	20.41	12.25	7.55
9. Lamps G. F.	19.43	15.40	15.50	10.60	11.01	6.71	8.46	8.04	6.80	12.40
10. Lamps Vacuum	16.58	11.80	12.20	7.15	9.22	7.41	7.54	3.33	1.41	2.83
11. Torch Bulbs	2.84	3.04	2.23	1.80	2.30	2.01	1.49	63	82	1.29
12. Automobile Bulbs	1.02	86	81	74	84	1.09	1.47	53	29	47
13. Electric Fittings (including switches)	8.11	6.09	5.04	5.02	6.25	5.18	6.28	2.78	1.82	2.50
14. Batteries	20.61	25.70	19.50	15.50	20.22	7.10	1.16	3.58	1.04	1.75
15. Electrical Porcelain Ware	...	...	1.03	98	1.24	93	1.06	37	29	1.01
16. Meters	10.46	10.72	9.24	9.28	12.56	8.08	15.20	5.42	2.23	2.80
17. Fans	32.51	33.00	24.10	18.15	16.60	11.40	8.49	7.03	4.71	1.13
18. Electric Medical apparatus	5.00	3.44	5.06	3.50	4.72	4.74	6.60	2.30	1.69	3.90
19. Telegraph and Telephone instruments	17.50	18.10	17.30	16.35	11.30	10.80	11.80	6.90	7.35	13.30
20. Electric Sound recording equipments	...	3.10	4.44	2.86	2.00	3.14	3.28	81	25	1.07
21. Refrigerating Machinery	14.33	15.00	21.90	10.00	18.90	14.38	14.87	1.77	4.14	3.18
22. Control & Switch Gear	14.35	46.00	42.50	65.30	63.00	39.40	45.60	41.10	34.00	43.30
23. Generators, Alternators & Dynamos	21.59	37.30	20.00	26.72	23.40	13.01	16.35	16.47	18.10	17.40
24. Cost index figure	1.00	1.00	1.00	1.00	1.12½	1.25	1.37½	1.50	1.62½	1.75

APPENDIX VI.

Questionnaire issued to the Office of the Electrical Commissioner with the Government of India and their Reply.

Question 1.—What is the actual or anticipated Provincewise “installed electrical power generation plant capacity in KW” in the following years :—

Year	Installed electrical power generation plant capacity in KW		
	Hydro	Steam	Oil Engine
Actual in 1939			
Anticipated in Dec. 1946			
Anticipated in Dec. 1953			
Anticipated in Dec. 1958			
Anticipated in Dec. 1963			

Reply 1.—Actual and anticipated Provincewise installed Generating Capacities in 1939, 1946, 1953, 1958, and 1963.—The installed electrical power generating capacity as at 1939 and 1946 are given provincewise in Appendix VIII under the different categories Hydro, Steam and Oil. The estimated figures for 1953 are also given. For the years 1958 and 1963 we have endeavoured to make a forecast of the approximate total generating capacity for the whole of India, but in view of the rapidly changing conditions in various provinces it is not possible to make a provincewise distribution of the total generating capacity.

The attached statement indicates that the generating capacity in Ajmer in the form of diesel engine generating sets remains stationary after 1946. This is due to the fact that Ajmer is likely to be included in the area served by the Chambal Hydro-Electric Scheme.

Similarly no increase in the installed generating capacity in Coorg is indicated as it is anticipated that they will find it economical to obtain bulk supply either from the Madras or from the Mysore Hydro-Electric Grids. They have a Hydro-Electric Scheme under investigation but it is too early to say whether it will be implemented.

Question 2.—What is the actual or anticipated “installed electric load capacity in KW” in the following years :—

Year	Installed electric load capacity in KW				
	Lighting	Fans	Domestic load other than light, fans, motor load	Industrial load other than lights, fans and motor loads	Motor load
Actual in 1939					
Anticipated in Dec. 1946					
Anticipated in Dec. 1953					
Anticipated in Dec. 1958					
Anticipated in Dec. 1963					

Reply 2.—Statement showing connected load in various categories in the whole of India including Indian States.—In the statement (at Appendix IX) the figures indicating the division of the connected load in the various categories is based on actual figures received from public electric utilities for the year 1946. The corresponding figures for the years 1939, 1953, 1958 and 1963 have been estimated.

Question 2.—What is the anticipated approximate cost in rupees of the electrical portion of the (a) likely projected additions to existing installed generating capacity, (b) new schemes which have either been sanctioned or are likely to be sanctioned in the near future and which are reasonably likely to be in commission by the end of 1953, and (c) for such portion of possible schemes which may be in commission by the end of 1953.

For the purpose of determining cost, the Electrical Commissioner may assume a rate as was ruling in 1939.

Reply 3.—Cost of Electrical portion of Generating plant in Hydro-Electric, Steam and Diesel Engine driven power stations.—In view of the wide variety of plant and large range of prices, it is only possible to make a very approximate estimate of the electrical portion of the likely extensions and new projects. In the present stage of manufacture in India, most of the plant requirements of the electric power development projects may have to be imported from outside for some time to come.

The figures given below are based on the level of prices ruling in 1945-1946 and include plant required for generating stations only. The plant and equipment required for sub-stations and receiving stations are excluded, as these cannot be estimated until the layout of the systems is decided, and many of the schemes included below are still in the stage of planning.

Type of Generating Plant	Additional capacity that is likely to be installed by end of 1953 in Meg.watts	Approximate cost of plant
		Rs.
Steam-Electric	682.543	30.7 crores
Hydro-Electric	626.317	15.7 crores
Diesel-Electric	13.060	0.46 crores

Question 4.—What is the anticipated approximate cost in rupees of that part of the electrical portion of the equipment referred to in Question 3 above which is anticipated to be of indigenous manufacture on the existing basis of production?

For the purpose of determining the cost, rates ruling in 1939 may be adopted.

Reply 4.—Possibilities of Indigenous Manufacture of Electrical Machinery and Equipment.—No appreciable part of the plant under reply to question 3 for the various electric power generating schemes is likely to be supplied by indigenous industries, at least for the next five years.

The estimates received by this office from the various Provincial and State Governments in respect of the power expansion schemes relate only to requirements of heavy electrical plant which comprise the following categories:—

1. Turbo-alternators of individual capacity of 1000 KW. and over.
2. Water tube boilers of individual capacity of 11,000 lbs./hr. and over.
3. Water wheel alternator sets of individual capacity of 500 KW. and over.
4. Diesel generating plant having an individual capacity of 500 KW. and over.
5. Transformers of voltages 13.2 KV and over and of lower voltages aggregating 5,000 KVA capacity and over in respect of any particular project.
6. High voltage switchgear of 13.2 KV. and over and all lower voltages aggregating 5000 KVA. capacity and over in respect of any particular project.
7. Synchronous condensers, Rotary Converters and motor-generator sets having an individual capacity of 250 KW. and over.
8. Mercury Arc Rectifiers of an individual capacity of 250 KW. and over.
9. Extra High Voltage Cables of 13.2 KV. and over.

Out of the above plant existing manufacturing capacity in India is limited to transformers upto 500 KVA and for high voltages upto 11,000 volts, and isolating switches upto 110 KV. Under the category or transformers our estimates include those having an individual capacity of 5,000 KVA or an aggregate of 5,000 KVA for schemes where similar transformers are required. The proportion of transformers under 500 KVA included in the figures given in the reply to question 3 comprises above 2 per cent. of the total value of each power station.

The data in our possession is insufficient for an estimate of the total requirement of India for transformers of 500 KVA and of smaller sizes. The Department of Industries and Supplies controlled imports of transformers of 250 KVA and of smaller sizes under the "Panel Scheme" and they could no doubt furnish estimates of the total requirements of the country of distribution transformers, in sizes which can at present be manufactured in India.

With regard to isolating switches and switchgear, only a small portion of the total requirement is at present manufactured in India.

Question 5.—Will the Electrical Commissioner to the Government of India kindly state if he has prepared or recommended to the Government of India or to any of the Provincial Governments or Indian States standards in respect of types and/or sizes of the following electrical equipment that might be required in connection with the proposed electrification of rural areas and if so kindly state the nature of such recommendation :—

- (a) inside and outside wiring of rural buildings,
- (b) distribution lines in rural areas, and
- (c) voltage and phases of A. C. distribution in rural areas.

Reply 5.—*Standards in respect of types and sizes of wiring equipment, etc.*—The question of standardisation of an economic system of indoor and outdoor wiring for rural schemes and cheap distribution lines for rural areas, will be tackled as soon as we can do so.

With regard to the voltage of A. C. distribution in rural areas although no standards have been laid down, we have no hesitation in saying that the obvious system will be 11,000 volts A. C. 3-phase 50 cycles for High Tension distribution and 400 volts A. C. 3-phase four wire system of Low Tension distribution.

Question 6.—What is the total number of public electric supply power stations in India classified under the following heads :—

- (i) generating Direct Current supply.
- (ii) generating Alternating Current supply—50 cycle.
- (iii) generating Alternating Current supply—25 cycle.
- (iv) generating Alternating Current supply—60 cycle.
- (v) generating Alternating Current supply—110 volt supply.

Reply 6.—Number of Public Electric Supply Undertaking in India classified according to systems of supply are as follows :—

Direct Current system	102
Alternating Current 50 Cy. System	298
Alternating Current 25 Cy. System	3
Alternating Current 60 Cy. System	1
Alternating Current 40 Cy. System	1
Alternating Current 110 Volts System	Nil
Total ...	405

Question 7.—In regard to the electric power stations generating Direct Current, 25 cycles and 60 cycles A. C. supply and 100 volt A.C. supply, what action, if any, has been taken, or proposed to be taken, by the Electrical Commissioner with the Government of India, to assist in the conversion of these supplies to alternating current 50 cycles, 230/440 volts.

Reply 7.—*Action taken to assist conversion of existing D. C. and A. C. 25 cycle, 60 Cycle, and 110 volt A. C. supply systems to standard 50 cycle 400/230 volt systems.*

The conversion of electric supply systems from non-standard to standard A.C. 50 cycles 400/230 volts must necessarily be a gradual process, for it introduces several technical and financial problems. The Office of the Electrical Commissioner is adopting the policy of advising undertakings to limit additions or extensions to non-standard generating plant to the minimum and in encouraging the utilities concerned to change over to the standard 50 cycles supply. The figures in the next paragraph will indicate that we do not anticipate any increase in the number and total capacity of installations having non-standard systems of supply.

Question 8.—In regard to the anticipated installed load capacity in India by the end of 1953, what is likely to be the percentage of (a) load for Direct Current, (b) load for A. C. 25 cycles, and (c) load for A. C. 60 cycles.

Reply 8.—*Anticipated Connected load capacity by 1953 on various non-standard systems.*—Estimated connected load capacity in India in 1953—3,920,000 Kilos—

- (a) Estimated load for D. C.—286,893 KW—7.32 % of total installed load.
- (b) Estimated load for A. C. 25 cycles—62,690 KW.—1.6% of the total installed load.
- (c) Estimated load for A. C. 60 cycles—5,618 KW—0.14% of the total installed load.

Question 9.—Will the Electrical Commissioner kindly give the Panel some indication and also broad outlines in general on which the electrical developments of the Provincial Governments are going on in India?

Reply 9.—Broad outline on which electrical development in various Provinces is proceeding.—It will be noted from a comparison of Tables 1-A, 1-B, 1-C and 1-D of Appendix VIII that there is expected to be considerable increase in the installed generating capacity in various Provinces by 1953. Wherever Hydro resources are available and these can be developed economically, the Provincial Governments are taking active steps to implement such schemes. In other cases, where such resources are lacking or their exploitation would be uneconomical, power stations are being constructed to provide power for industrialisation and for irrigation purposes by means of Nursery Power Schemes. The increase in the generating capacity indicated in the above tables would be accompanied by a corresponding increase in transmission and distribution lines and thus electrical power will be available to very much larger areas, and to a much larger percentage of the population of India than at present. The Governments of Bombay, C. P., Bengal, U. P. and Punjab and some of the Indian States are all actively planning "Nursery Power Schemes" each of which would comprise a Diesel Engine operated Power Station with a capacity of about 200/300 K.W. with a number of 11 K.V. distribution lines radiating to surrounding villages and small towns. It is expected that electrical energy would be sold at economic rates even though this might involve a small loss for the first few years. Once the masses understand the advantages of electric power and derive the benefits of larger production with less manual labour and devices employing cattle (*e.g.*, for raising water or for oil mills) the demand for electric power will increase sufficiently to enable the distribution system to be connected to a larger grid transmitting power at 66 or 132 KV and generating power either in a large steam or a hydro station.



APPENDIX VII

Analysis of Electrical Energy Generated in India in 1939 (Public Utilities only.)

Kilowatt hours generated in millions

—	Steam	Diesel	Hydro	Total	kwh. generated per capita (approx)	kwh. generated per sq. mile (approx)
Ajmer-Merwara .	...	1·729	...	1·729	2·96	720
Assam . .	...	1 615	1·009	2·624	0·26	48
Baluchistan . .	...	1·685	...	1·685	3·36	31
Bengal . .	546·859	5·550	1·568	553·977	9·19	7153
Bihar . . .	47·248	4·976	...	52·224	1·44	749
Bombay . .	120·282	18·868	696·668	835·818	40·09	10934
C. P. . . .	11·875	3·927	...	15·802	0·94	160
Coorg . . .	...	...	...	...	...	...
Delhi . . .	32·841	2 878	...	35·719	38·91	62228
Madras . .	65·928	11·199	147·700	224·827	4·58	1782
N. W. F. P. .	2·025	0·831	5·409	8·265	2·72	579
Orissa . . .	...	1·027	...	1·027	0·12	32
Punjab . .	39·184	10 719	79·559	129·453	4·56	1806
Sind	0·443	29·633	...	30·076	6·63	626
U. P. . . .	155·305	3 054	98·493	256·852	4·67	2417
Total . . .	1,021·990	97·682	1030·406	2,150·078	7·27	2484
STATES						
Baroda . . .	...	6·304	...	6·304	2·21	771
Bikaner . . .	9 802	...	...	9·802	7·58	423
Hyderabad . .	19·513	2·134	...	21·647	1·33	263
Kashmir . . .	...	0·066	18·837	18·903	4·79	270
Mysore . . .	...	...	259·056	259·056	35·35	8794
Rampur . . .	2·424	...	...	2·424	5·08	2711
Travancore . .	...	1·703	4·198	5·901	0·97	770
Other States .	26·031	82·160	0·621	58·812	1·07	119
Total . . .	57·770	42·367	282·712	382·849	4·12	535
Total for All India.	1,079·049	140·049	1313·118	2,532·927	6·5	1602

APPENDIX VIII

Installed Capacity of Electrical Power Generating Plants in Public Electric Utilities in 1939.—
Provincewise tabulation

TABLE 1-A.

Province	Steam	Hydro	Diesel/Gas	Total	Remarks
Ajmer . . .	...	...	1,394	1,394	
Assam . . .	...	500	1,506	2,006	
Baluchistan . .	...	...	1,250	1,250	
Bengal . . .	267,907	1,400	3,598	272,905	
Bihar . . .	21,600	...	3,418	25,018	
Bombay . . .	67,407	232,114	15,918	315,439	
C. P. . . .	10,139	...	3,616	13,755	
Coorg . . .	...	...	...	...	Started in 1942
Delhi . . .	10,900	...	4,386	15,286	
Madras . . .	47,150	69,650	7,282	124,082	
N. W. F. P. . .	2,300	9,600	9,880	12,880	
Orissa . . .	...	...	856	856	
Punjab . . .	26,478	49,750	13,309	89,537	
Sind . . .	275	...	13,635	13,910	
U. P. . . .	89,773	22,700	8,120	120,393	
Mysore . . .	...	45,000	...	45,000	
Travancore . .	...	15,400	1,443	16,843	
Hyderabad . .	9,750	...	3,151	12,901	
Kashmir . . .	...	4,315	265	4,580	
Other States . .	19,584	340	28,116	43,040	
Total . . .	573,063	450,769	112,243	1,136,075	

Installed capacity of Electrical Power Generating Plant in KW in Public Electric Utilities
in 1946—Provincewise tabulation

TABLE 1-B

Province	Steam	Hydro	Diesel	Total
Ajmer . . .	...	...	1,394	1,394
Assam . . .	320	500	2,204	3,024
Baluchistan . . .	...	...	1,250	1,250
Bengal . . .	349,051	2,760	4,411	356,222
Bihar . . .	27,200	...	3,962	31,162
Bombay . . .	82,407	232,114	17,064	331,585
C. P. . . .	23,639	...	3,988	27,627
Coorg . . .	...	...	74	74
Delhi . . .	24,900	...	6,385	31,285
Madras . . .	55,650	97,050	5,840	158,540
N. W. F. P. . .	...	9,600	1,030	10,630
Orissa . . .	...	...	1,221	1,221
Punjab . . .	26,476	49,750	13,613	89,839
Sind . . .	6,025	...	15,689	21,714
U. P. . . .	138,245	22,700	8,430	169,375
Mysore . . .	...	73,000	...	73,000
Travancore . . .	...	15,400	1,547	16,947
Hyderabad . . .	16,750	...	3,151	19,901
Kashmir . . .	1,500	4,005	265	5,770
Other States . .	23,023	340	30,007	53,370
Total . . .	775,186	507,219	121,525	1403,930

Estimated Figures of Installed Generating Capacity in Public Electric Utilities in 1953

TABLE No. 1-C

Province	Steam	Hydro	Diesel	Total
Ajmer . . .	...	...	1,394	1,394
Assam . . .	427	667	2,939	4,033
Baluchistan . . .	...	...	1,667	1,667
Bengal . . .	723,051	7,760	4,411	735,222
Bihar . . .	114,700	44,000	4,358	163,058
Bombay . . .	132,407	336,114	19,494	488,015

Province.	Steam	Hydro	Diesel	Total
C. P.	43,639	...	4,500	48,139
Coorg	...	...	74	74
Delhi	44,900	...	6,385	51,285
Madras	79,650	223,600	5,840	309,090
N. W. F. P.	...	14,600	1,030	15,630
Orissa	2,000	...	2,000	4,000
Punjab	28,976	99,750	14,974	143,700
Sind	18,025	8,400	10,689	43 114
U. P.	171,245	127,100	9,000	307,345
Mysore	...	181,000	...	181,000
Travancore	...	37,900	1,547	39,447
Hyderabad	54,250	10,000	3,151	67,401
Kashmir	1,500	10,005	265	10,270
Other States	42,773	32,640	34,867	111,780
Total	1,457,543	1,133,536	134,585	2,725,664
Total—1958	1,675,000	1,470,000	141,200	3,286,200
Total—1963	1,890,000	1 810,000	148,000	3,848,000

Summary of total installed capacities of Generating Plant in Public Electric Utilities for the whole of India including Indian States between 1939 and 1963

TABLE No. 1-D
All figures in Megawatts

Type of Plant	1939	1946	1953	1958	1963
A) Steam Electric	573·063	775·186	1,457·543	1,675·000	1,890·000
Percentage increase on 1939 figures.	...	35%	154	192	230
(B) Hydro Electric	450·769	507·219	1,133·536	1,470·000	1,810·000
Percentage increase on 1939 figures.	...	12%	147	226	300
(C) Diesel Electric	112·243	121·525	134·585	141·200	148·000
Percentage increase on 1939 figures.	...	7%	20	26	32
(D) Total	1,136·075	1,403·930	2,725·664	3,286·200	3,848·000
Percentage increase on 1939 figures.	...	24%	145	194	245

APPENDIX IX

Statement showing connected load in various categories in the whole of India including Indian States in 1939 and 1946 and approximate estimate of connected loads in 1953, 1958 and 1963.

Year	Installed Electric Load Capacity		Remarks
	Domestic Load	Industrial load	
	KW (a)	KW (b)	
	Rs.		
1939	635,200	905,600	Approximate estimated loads under:—
46	780,905	1,109,620	(a) Lighting . 19%
1953	1,362,200	2,077,000	Fan . . . 73%
1958	1,756,000	2,497,000	Heating & others. 8%
1963	2,054,000	2,916,000	(b) Motor . 91%
			Heating, Welding, etc. 9%

APPENDIX X

Statement showing proposed allocation of Spindleage to various Provinces and States in India.

Zone	Provinces and States	Fine Spindles	Coarse Spindles
Bombay Surplus Area	Bombay Presidency	114,000	...
	Baroda	38,000	...
	Nawanagar	...	25,000
	Junagadh	...	25,000
	Bhavnagar	...	25,000
	Cambay	19,000	...
Sind Zone	Sind Province	...	75,000
	Khairpur	...	25,000
Punjab Zone	Punjab Province	114,000	323,000
	Delhi Province	...	...
	N. W. F. P.	...	...

Zone	Provinces and States	Fine Spindle	Coarse Spindles
	Bahawalpur	...	50,000
	Nabha	...	25,000
	Kapurthala	...	25,000
United Provinces Zone .	United Provinces	114,000	150,000
	Benares State	...	25,000
Bihar Zone	Bihar Province	38,000	175,000
Bengal Zone	Bengal Presidency	125,000	200,000
	Assam Province	100,000	(Coarse and fine mixed)
	Seraikala	...	25,000
Orissa Zone	Orissa Province	19,000	100,000
	Mayurbhunj	...	25,000
Central Provinces Zone .	Central Provinces	76,000	75,000
	Rewa	...	25,000
South Zone	Madras Presidency	152,000	200,000
	Hyderabad	19,000	50,000
	Mysore	19,000	25,000
	Travancore	...	50,000
	Cochin	...	25,000
	Pudukottah	...	25,000
Rajputana Zone	Gwalior	19,000	...
	Bharatpur	...	25,000
	Bikaner	...	25,000
	Dholpur	...	25,000
	Alwar	...	25,000
	Palanpur	19,000	...
Total		885,000	fine spindles.
		1,873,000	coarse spindles.
		100,000	for Assam, coarse and fine toge- ther.
		2,858,000	

APPENDIX XI.

LIST OF ELECTRICAL MACHINERY REQUIRED BY TEXTILE MILLS

Machinery required per mill of 10,000 Fine Counts Spindles.

Blow Room Machinery—

	H.P.
1 Hopper Bale Opener	2
1 Roving Waste Opener	3
1 Auto hopper Opener	1
1 Peep-line Opener	2
1 Inter or breaker Scutcher	4
1 Horizontal exhaust Opener & Scutcher	9
1 Finishing Scutcher (16 oz. Lap)	8
Individual Drive	30
Group Drive	45

Spinning Machinery—

	H.P.
22 Carding Engines, 1 H.P. each	22
1 Silver Lap machine, $\frac{1}{2}$ H.P. each	$\frac{1}{2}$
1 Ribbon Lap machine, 1 H.P. each	1
8 Combing Machines, $\frac{3}{4}$ H.P. each	6
3 Drawing Frames of 2 Heads of 5 Deliveries 1 H.P. each	3
1 Slubbing Frame (100 Spindles), $2\frac{1}{4}$ H.P. each	$2\frac{1}{2}$
2 Intermediate Frames (142 Spindles), $2\frac{3}{4}$ H.P. each	$5\frac{1}{2}$
6 Roving Frames (180 spindles) $2\frac{3}{4}$ H.P. each	$16\frac{1}{2}$
10,500 Ring Spindles, i.e., 26 Ring Frames, $7\frac{1}{2}$ H.P. each	195
Individual Drive	252 $\frac{1}{2}$
Group Drive	290

Weaving Preparatory Machines—

	H.P.
10 Vertical spindle winder, $\frac{3}{4}$ H.P. each	$7\frac{1}{2}$
9 Universal Weft Winder, 1 H.P. each	9
6 Warper (Bean Winder) 1 H.P. each	6
4 Sizing Machines, 2 H.P. each	8
60 Reeling Frames, $\frac{1}{2}$ H.P. each	15
Individual Drive	45
Group Drive	55

Weaving Shed—

	H.P.
233 Looms, $\frac{3}{4}$ H.P. each	175
Individual Drive	175
Group Drive	215

Bleaching Machinery -

	H P
1 Four Burner Singeing Machinery	5
1 Shearing Machine	8
2 Vertical High Pressure Gears 15 H.P. each	30
2 Washing Machines, 10 H.P. each	20
2 Chomicking Machines, 10 H.P. each	20
1 Squeezing Machine 12 H.P. each	12
Individual Drive	95
Group Drive	119

Dyeing Machinery—

	H.P.
4 Jiggers, 1½ H.P. each	9
2 Three Bowl Padding Machinery, 15 H.P. each	30
1 Padding Machine, with Hot Air Drying Range	25
1 Developing Range	12
1 Package Dyeing Machine	15
1 Choose and Beam Dyeing Machine	12
Individual Drive	100
Group Drive	125

Printing and Finishing Machinery—

	H P
1 Brushing and Bleaching Machinery, 12 H.P. each	12
1 Colour Mixing Pans, 5 H.P.	5
1 Three Colour Printing Machines with Drying Range	25
1 Rapid Ager	5
1 Aneline Ager	5
1 Developing Range	5
1 Two Bowl Mangle with Drying Range 29 Cylinder Horizontal	12
Drying Machine	9
1 29 Cylinder Horizontal Drying Machine with water mangle	15
1 90 Stentor with Jigging device	25
1 Fan for the stentor	25
1 Cloth Mercerising Machine	40
1 Yarn Mercerising Machine	40
1 Five Bowl Universal Calender	50
1 Three Bowl Universal Calender	30
1 Schreiner Calender	16
1 40 Stentor Open Type with Weft Straightener	20
1 Fan for the Stentor	25
Individual Drive	364
Group Drive	400

Folding Machinery—

	H.P.
10 Folding Machineries, 1 H.P. each	10
4 Stamping Machines, ½ H.P. each	2
2 Baling Press, 20 H.P. each	40
Individual Drive	52
Group Drive	68

Electrolyser Plant

	H.P.
1 Electrolyser Motor Generator, Self or 40 Cells	150
1 Electrolyser Motor Pump	1½
1 Electrolyser Motor Chloride Pump	2½
Individual Drive	154

Summary of Power Required

	H.P.
Blow Room	45
Spinning	290
Weaving Preparatory	55
Weaving Shed	215
Bleaching	110
Dyeing	125
Printing and Finishing	400
Folding	68
Electrolyser Plant	154
	1,462
Auxiliaries and Humidification	200
	1,662-1,246
	K.W

SECTION A.

Motors for Individual Drive

Motors	H.P. each
60	½
3	½
183	½
51	1
6	1½
4	2
2	2½
8	2½
1	3½
1	4
5	5
26	7½
2	8
2	9
4	10
4	12
2	15
3	20
1	30
2	40
1	50
1 Motor Generator	180

SECTION B.

Motor for Group Drive

Motor	H.P. each
1	1½
1	2½
6	5
1	8
1	9
4	10
5	12
7	15
4	20
32	25
1	30
2	40
1	50
1 Motor Generator	150

SECTION C.

Total Motors required for Individual Drive

(For distribution of 935,000 Ring Spindles, Fine Counts)

Motors	H.P. each
5,580	½
279	½
17,019	½
4,743	1
558	1½
372	2
186	2½
744	2½
93	3½
93	4
465	5
2,418 (Variable speed)	7½
186	8
186	9
372	10
372	12
744	15
279	20
93	30
186	40
93	50
Total 34,061 Motors	
93 Motors Generator	150

SECTION D.

Total Motors required for Group Drive

(For distribution of 935,000 Ring Spindles, Fine Counts).

Motors	H.P. each
93	1½
93	2½
558	5
93	8
93	9
372	10
465	12
744	15
372	20
2,976	25
93	30
186	40
93	50
Total 6,231 Motors	
93 Motor Generator	150

MACHINERY REQUIRED PER MILL OF 4,000 COARSE COUNTS SPINDLES.

Blow Room Machinery—

	H.P.
1 Hopper Ball Opener	2
2 Roving Waste Opener	3½
1 Auto Silver Fitter	1½
1 Porcupine Opener	2
1 Vertical or Creighton Opener	8
1 Vertical with single Scutcher	4
1 Inter Air Breaker Scutcher	8
1 Finishing Scutcher (10 oz. Lap)	4

Individual Drive . . . 33
 Group Drive . . . 42

Spinning Machinery—

15 Carding Engines, 1 H. P. each	15
3 Drawing Frames of 2 Heads of 5 Deliveries each, 1 H. P. each	3
1 Soving Frame, 100 Spindles, 2½ H. P. each	2½
2 Intermediate Frames, 142 Spindles, 2½ H. P. each	5½
3 Roving Frames, 180 Spindles each 2½ H. P. each	8½
4,000 Ring Spindles, i.e., 10 Ring Frames, 400 Spindles each, 7.5 H. P. each	75

Individual Drive . . . 109½
 Group Drive . . . 124

Weaving Preparatory Machines—

6 Vertical Spindle Winders, ¾ H. P. each	4½
5 Universal Weft Winders, 1 H. P. each	5
4 Warper Deam Winder, 1 H. P. each	4
2 Sizing Machines, 2 H. P. each	4
30 Reeling Frames, ¼ H. P. each	7½

Individual Drive . . . 25
 Group Drive . . . 32

Waving Shed.—

H. P.

125 Looms, $\frac{3}{4}$ H.P. 94Individual Drive . . . 94
Group Drive . . . 126*Bleaching Machinery.*—

H. P.

1 Four Burner Singeing Machinery 5

1 Shearing Machine 8

2 Vertical High Pressure Gears 15 H. P. each 30

2 Washing Machines, 10 H. P. each 20

2 Chemicking Machines, 10 H. P. each 20

1 Squeezing Machine, 12 H. P. each 12

Individual Drive . . . 95
Group Drive . . . 110*Dyeing Machinery .—*

H. P.

4 Jiggers, $1\frac{1}{2}$ H. P. 6

2 Three Bowl Padding Machinery, 15 H. P. each 30

1 Padding Machine, with Hot Air Drying Range 25

1 Developing Range 12

1 Package Dyeing Machine 15

1 Cheese & Beam Dyeing Machine 12

Individual Drive . . . 100
Group Drive . . . 125*Printing & Finishing Machinery.*—

H. P.

1 Brushing & Bleaching Machinery, 12 H. P. each 12

4 Colour Mixing Pans 5

1-3 Colour Printing Machines with Drying Range 25

1 Rapid Agor 5

1 Aneline Agor 5

1 Developing Range 5

1 Two Bowl Mangle with Drying Range 12

1-29 Cylinder Horizontal Drying Machine 9

1-29 Cylinder Horizontal Drying Machine with water Mangle. 15

1-90" Stentor with Jigging Devided 25

1 Fan for the Stentor 25

1-40" Open Type Stentor with Weft Straightener 20

1 Fan for the Stentor 25

1 Cloth Mercerising Machine 40

1 Yarn Bowl Universal Calender 50

1 Three Bowl Universal Calender 30

1 Schreiner Calender 16

Individual Drive . . . 364
Group Drive . . . 400*Folding Machinery.*—

H. P.

5 Folding Machineries 1 H. P. each 5

2 Stamping Machines, $\frac{1}{2}$ H. P. each 1

1 Baling Press 20

Individual Drive . . . 26
Group Drive . . . 34

Electrolyser Plant—

	HP.
1 Electrolyser Motor Generator for 24 Cells	75
1 Electrolyser Motor Pump	1½
1 Electrolyser Chloride Pump	2½
Individual Drive	79
Group Drive.	..

Summary of power Required—

	H. P
Blow Room	42
Spinning	124
Weaving Preparatory	32
Weaving Shed	126
Bleaching	110
Dyeing	125
Printing & Finishing	400
Folding	34
Electrolyser	79
	1,072
Auxiliaries and Humidification	200
	1,272
	= 954 K.W

SECTION A.*Motors required for Individual Drive*

Motors	H. P. each
30	1½
2	1½
131	½
32	1
6	1½
4	2
2	2½
5	2½
1	3
1	3½
2	4
10	7½
3	8
1	9
4	10
5	12
5	15
1	20
5	25
2	30
2	40
1	50
1	75

SECTION B.

Motors Required for Group Drive:

															H. P. each.
Motor															
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1½
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2½
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	75

SECTION C.

Total Motors Required for Individual Drive

(For distribution of 1,923,000 Ring Spindles Course Counts)

																H. P. each
Motors																
14,400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	½
960	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	½
32,880	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	½
15,360	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
2,880	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1½
1,920	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
960	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2½
2,400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2½
480	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
480	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3½
960	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
4,800	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7½
1,440	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
480	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
1,320	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
2,400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
2,400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
480	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
2,400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25
960	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30
960	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40
480	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50

AL 122,400

480 Motor Generators 75 H. P. each.

SECTION D.

Total Motors required for Group Drive

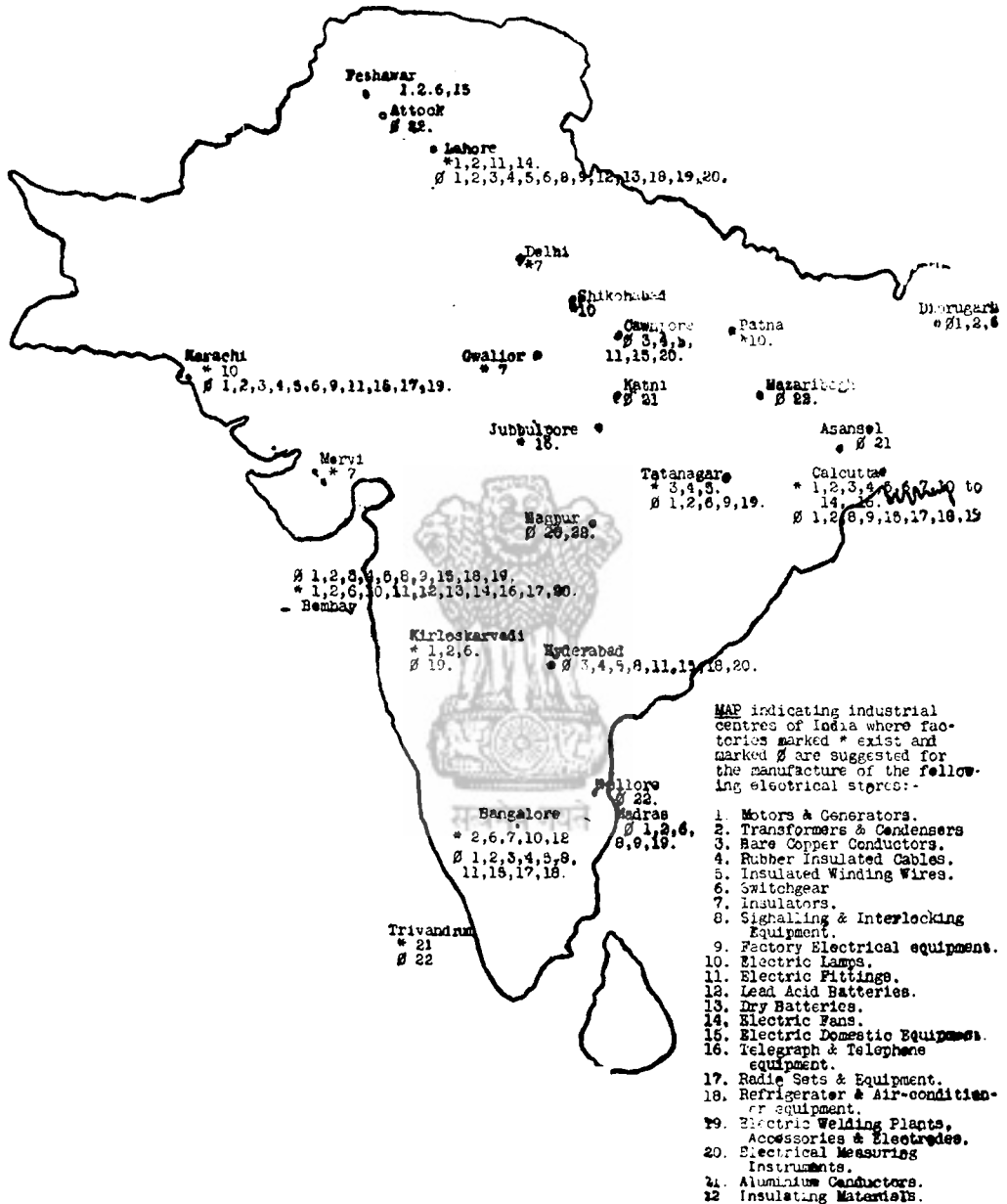
(For distribution of 1,923,000 Ring Spindles, Course Counts)

Motors	H. P. each
480	1½
960	2½
1,440	5
1,920	10
2,400	12
2,400	15
1,440	20
7,200	25
1,440	30
960	40
480	50
21,220	

480 Motor Generators 75 H P each.



APPENDIX XII



NOTE: Factories having less than an annual output of Rs. 25 lakhs value are not shown.